THE

EDINBURGH SCHOOL

OF

MEDICINE;

CONTAINING THE

PRELIMINARY OR FUNDAMENTAL BRANCHES

OF

PROFESSIONAL EDUCATION,

VIZ.

ANATOMY, MEDICAL CHEMISTRY, AND BOTANY.

Intended as an

INTRODUCTION TO THE CLINICAL GUIDE.

THE WHOLE FORMING A COMPLETE SYSTEM OF MEDICAL EDUCATION AND PRACTICE ACCORDING TO THE ARRANGEMENT OF THE EDINBURGH SCHOOL.

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THE

ANATOMICAL GUIDE;

OR,

A VIEW

OF THE

ANATOMY AND PHYSIOLOGY

OF THE

HUMAN BODY,

IN THE

SOUND AND MORBID STATE;

WITH THE

APPLICATION OF CHEMISTRY,

AND THE CHIEF MODES OF ANATOMICAL PREPARATION WHICH HAVE BEEN EMPLOYED IN ORDER TO FACILITATE THE EXPLANATIONS OF ITS STRUCTURE.

TO

DR. MATTHEW BAILLIE,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, F. R. S. &c. &c.

The Anatomical Part of this Work is Inscribed, as a Mark of Professional Respect, and as a proper Return for the many valuable Observations it contains, derived from his Writings; by

THE AUTHOR.

CONTENTS.

DEMONSTRATION

AND

DISSECTION.

I.

FROM the chylopoetic viſcera, our attention is next directed to thoſe organs which are termed their aſſiſtants. The principal of them is the liver.

II.

LIVER.

This organ is the largeſt gland in the body. It is of a duſky red colour, ſituated immediately under the diaphragm, in the right hypochondrium, and its bounds are touched by the edge of the thorax, expanding to the region of the ſtomach, and even to the left hypochondrium. On its upper ſurface it is convex and ſmooth, where oppoſed to the diaphragm, only flattened on its left ſide, where its ſurface meets the ſituation

of the heart. On its under ſide its ſurface is irregular, though at the ſame time concave, and here it is oppoſed to the ſtomach and inteſtines.

III.

Towards the ribs it is thick, and gradually becomes thinner as it advances forwards towards the left ſide. On its poſterior edge it is blunt or obtuſe. On its anterior it is ſharp or acute, and from ſide to ſide its breadth exceeds what it does from before backwards.

IV.

Lobes.

In entering into a particular deſcription of the liver, the firſt parts of it to be demonſtrated are its lobes, and theſe are divided into its great and ſmall ones, which are ſo conſiderable, as to form its body and whole upper part. In point of ſituation, the great lobe is placed obliquely in the right hypochondrium, and follows the curve of the diaphragm; while the ſmall one, divided by a broad ligament, is ſituated almoſt horizontally.

V.

Beſides theſe lobes, ſome ſmaller ones alſo fall to be noticed, as, 1. The lobe of Spigelius, ſituated on the left ſide of the great lobe, near the ſpine, and projecting like a nipple at the ſmall curvature of the ſtomach: 2. The lobulus caudatus, an angle of the former, ſituated at the middle

of the lower ſide of the great lobe: and, 3. The lobulus anonymus, broader, though leſs prominent than the former lobule, and placed between the paſſage of the round ligament and the gall bladder.

VI.

Ligaments.

The next parts of this organ are its ligaments, or connecting proceſſes, which are chiefly formed from the doubling of the peritonæum.

1. The firſt is the ſuſpenſory one, or broad ligament, placed above between the great and ſmall lobes, and extending below into the umbilical fiſſure. It is connected obliquely to the diaphragm, and tip of the enſiform cartilage, and deſcending in the ſame direction, it adheres to the inner part of the ſheath of the rectus abdominis muſcle on the right ſide.

2. The round ligament, which is the remains of the umbilical vein, placed in a doubling at the under part of the former one, and fixed to the navel.

3. The right lateral ligament, which connects the thick great lobe at its back part with the poſterior part of the diaphragm.

4. The left lateral ligament, longer than the former one, and which ſerves for the connection of the left extremity of the ſmall lobe to the diaphragm.

5. To these is commonly added the external coat of the liver, which is merely cellular substance, and unites the root of the liver to the tendinous part of the diaphragm.

VII.

Thus, by the first of these ligaments is the liver preserved in the erect posture. By the second it is prevented, in lying down, from pressing on the diaphragm, so that they both suspend it, and prevent its pressure on the ascending cava.

VIII.

Fissures.

Next, after the lobes and ligaments of this organ, fall to be demonstrated its fissures or depressions, which are chiefly on its under side.

The first is the umbilical fissure between the great and small lobes, and at the under and fore part of the liver. This fissure is of different depth in different bodies, and behind it is commonly covered with the bridge or isthmus of the liver.

2. The second is the transverse fissure, or sinus portarum, extending from right to left between the great and small lobes, by which its extremities are bounded; and having the lobulus anonymus before, and that of Spigelius behind, the connection of these last forms an appearance

compared to a gate, and therefore diſtinguiſhed by the name of porta.

3. The intermediate depreſſion for the paſſage of the vena cava, between the great lobe and that of Spigelius, which has frequently a bridge over it, forming it into a canal.

4. The depreſſion of the ductus venoſus running a little obliquely from the right to the left ſide, and receiving a ligament, part of the umbilical veſſels.

IX.

From the peritonæum, this organ derives a coat which adheres cloſely to it, and every where it is covered by this membrane, except behind, where cellular ſubſtance connects it to the diaphragm.

X.

This organ is chiefly compoſed of a variety of veſſels, the extreme branches of which are intermixed in ſuch a manner, as to form numberleſs pulpy corpuſcules, termed acini, from their reſemblance to ſtones or ſmall kernels of fruit; and theſe again ſubjected to examination, appear compoſed of veſſels in the form of radiated villi.

XI.

From the importance of the liver, its circulation ought to be well underſtood. It is in this vaſcular congenies that diſeaſe is more apt to form than elſewhere, and it is here the blood

even loſes more of that principle on which its peculiar ſtimulus depends.

XII.

The principal artery of the liver is the hepatic, which is ſent off from the cæliac at the point of the Spigelian lobe. Its root is covered by the pancreas, and it paſſes under the ſtomach and duodenum, under the omentum and biliary ducts till it arrives at the porta; and having divided a little before into two branches, theſe enter the great and ſmall lobes of the liver. Being incloſed in the paſſage into the liver, on the cellular membrane, termed the gliſſoris capſule.

XIII.

Before its ſeparation, this artery in its progreſs gives off branches to different organs as it paſſes them. The firſt are ſmall twigs to the venæ portæ, and to the head of the pancreas, to the large branch termed the arteria duodeno gaſtrica, which again ſoon after its origin ſeparates into two principal diviſions, one of which ſupplies the ſtomach and omentum, named the gaſtro epiploic artery; the other pervades the duodenum, and gives circulation to the pancreas, termed arteria pancreatico duodenalis. Beſides theſe larger branches, ſmaller arteries alſo ariſe, one advances to the upper and back part of the duodenum, over the biliary ducts. Next go off ſmall arteries

to the duodenum, and alſo to the pancreas. Of theſe deſerving notice, is the lower pyloric artery, or branch of the pancreatico duodenalis, ſent off as it reaches the duodenum. Others ariſe at the ſame time, which encircle the pylorus, and chuſe a direction upwards, in order to inoſculate with twigs from the upper pyloric, which comes from the artery of the ſtomach.

The next artery, from the ſame origin, is a neat ſmall branch, named the tranſverſe pancreatic artery, paſſing under this organ, and running along its back part. It ſends branches into the ſubſtance of the viſcus from ſide to ſide, and is exhauſted after pervading $\frac{2}{3}$ of the gland. In its farther courſe along the circle of the duodenum, the arteria pancreatico duodenalis gives off arteries outwards to the duodenum, and inwards to the pancreas, till it ends by an inoſculation with the meſenteric artery.

XIV.

When the pancreatico duodenalis paſſes down, the other great diviſion formerly noticed, paſſes up to the ſtomach and omentum, named therefore the gaſtro epiploic artery. The courſe of this artery is along the lower part of the ſtomach, making a broad ſweep round its great arch. Branches are diſtributed by it in every direction along the organ, and alſo to the omentum. In its progreſs along the ſtomach it inoſculates with

the ſplenic artery, and the place of this, from inſpection, is uncertain; and, while the ſplenic artery forms the right artery of the ſtomach, this one is properly the left one. Another branch ſtill remains to be noticed, given off by the hepatic artery, before entering the liver. This is the

XV.

Pylorica Superior Hepatica,

Which comes off before the hepatic divides, or immediately after, from its left diviſion. It returns in a backward direction to the upper arch of the ſtomach, and expanding ſome ſmall twigs on the leſſer omentum, it paſſes directly on to the pylorus, with whoſe upper and lower arteries it forms inoſculations.

XVI.

Hepatica Siniſtra.

Within two inches of the liver, the hepatic artery is divided into two principal branches, which enter at the porta of the liver, but paſs the one to the right, the other to the left lobe of the organ. This branch to the left is ſmaller than the other. It climbs upon the vena portæ, and enters the liver at the foſſa umbilicalis. Its circulation within the liver is chiefly diſtributed to the left lobe, the lobe of Spigelius, and the anonymous lobe.

XVII.

Hepatica Dextra.

The right hepatic branch paſſes under the biliary ducts. With them it enters the right lobe of the liver, previous to which it gives off the arteria cyſtica, or branch that ſupplies the circulation of the gall bladder. Before conſidering the venous ſyſtem of the liver, it is proper to examine its appendage, or the gall bladder.

XVIII.

Gall Bladder.

It is a ſmall oblique pyriform bag, found on the under ſurface of the liver, half ſunk into the ſubſtance of the gland, and nearly horizontal when this organ is found in its place. It is touched by the duodenum and colon, ſo as to give a tinge of its ſecretion to theſe parts, and it inclines a little to the right ſide.

XIX.

This gland poſſeſſes four different coverings, or coats, in the ſame manner as the other bowels. The firſt, or external one, is derived from the peritonæum, and is the ſame that is expanded over the liver. The ſecond is its muſcular coat, which conſiſts rather of a few ſcattered fibres than any regular muſcular ſtructure. The third is a condenſed cellular texture, which is named its nervous coat; and the fourth, or its inner

ſurface, from its ſmall reticular rugæ, or folds, is termed its villous coat. This rugated ſtructure is more minute towards its neck than elſewhere, and its folds appear to run in a longitudinal direction. This internal covering is every where perforated by ſmall ducts, the excretories of ſmall follices, through which a mucus is diſcharged to defend the ſurface from the irritation of the biliary ſecretion.

XX.

Through its whole length, the gall bladder is connected by a cellular intermedium to the liver, as well as by its veſſels. Its principal veſſel, the cyſtic artery, already noticed, branches over it betwixt its coats in the form of a coronary artery, and being ramified in a beautiful manner, paſſes from it to the liver.

XXI.

The veins of the liver ariſe from two ſources, the vena portæ, and the terminations of its own arteries. The former is ſo named from its ſituation with reſpect to the porta of the liver. It conſiſts of the veins gathered together from the inteſtinal canal, and from the ſpleen, and pancreas, and its trunk lies obliquely acroſs the ſpine. On entering the liver, it diſtributes branches through the ſubſtance of the organ, and thus, from being derived from two origins, the hepatic veins are exceedingly numerous. The veins from both

origins unite by degrees, and accompany the other veſſels; but, at the root of the liver, they form two or three large trunks, which terminate at the vena cava on its perforation of the diaphragm. Thus the vena porta is a peculiar part in addition to the internal circulation of the liver, being a vein performing the office of an artery, by diſtributing the blood it collects from the arteries of the inteſtines, which blood is intended particularly for the ſecretion of the bile. From the extremities of the porta, therefore, the biliary ducts ariſe by extremely minute branches, termed pori biliarii, or tubuli biliferi, expanded over the ſubſtance of its pulpy corpuſcles. Theſe ducts gradually unite in their progreſs into larger branches, which collect at laſt into two, and run in the end into one, named the ductus hepaticus ſituated in the ſinus portarum.

XXII.

By the ductus hepaticus, the gall, or bile, of a yellow green colour, is conveyed from the liver; and by the appendage of the liver, the gall bladder, or receptacle of the bile, a duct is alſo ſent out, termed the cyſtic. The union of theſe ducts is termed the common one or choledochus, and through it the bile is received from the hepatic duct to be conveyed in part into the cyſtic one, and thus lodged in the gall bladder.

XXIII.

From confidering the general ftructure and circulation of the liver, we are led to examine its peculiar office of preparing and feparating the bile for the ufe of digeftion; for, whilft the bile promotes the diffolution and affimilation of the food, it irritates at the fame time the coats of the alimentary canal, and hence, when the flow of it into the gut is any how obftructed, the perfon becomes coftive.

XXIV.

It appears from a variety of circumftances, that the fecretion of the bile is chiefly made from the vena portarum. At firft fight this might be fuppofed from comparing the great fize of the ducts with the arteries, or from having obferved a very fingular connection of veins; the only purpofe of this, that can be reafonably fuppofed, is, that a certain change of the blood, and a certain momentum, different from what is feen in other parts of the body, is neceffary for the parts of the bile; for what other ufe can be affigned for this fingular courfe of the blood? But, befides mere probability, it is fully confirmed by making injections; and by thofe made from the vena portarum, the fecretion of the bile may be imitated, and pufhed into the biliary ducts; while, from the biliary ducts, though

it paſſes backwards with much more difficulty than forwards, yet it can be made to return.

XXV.

At the ſame time, there is reaſon to ſuſpect that a portion of the bile is derived from the hepatic artery; for, when this artery is followed to the liver, we find a branch ſent to the gall bladder, called the cyſtic artery, and it returns into the vena portarum, not into the vena cava, but all theſe branches ſpent upon the liver terminate in the vena cava. Since the concluſion to be drawn is, that the blood returns from the gall bladder into the vena portarum, becauſe no ſecretion of bile has been made directly from its branches into the gall bladder, it is not deprived of that ſomewhat fit for the formation: but the other branches having furniſhed this ſomewhat, return to the heart directly. And to confirm this, on making the ſame experiment upon the hepatic artery as upon the vena portarum, there is a ſimilar communication, though it is leſs evident; for, upon injecting the artery, the injection gets into the ducts, it is poſſible that the liquor may have penetrated into the vena portarum, or the beginning of the vena cava hepatica common to both: but ſtill there is a paſſage.

XXVI.

Thus the vena portarum chiefly makes the ſecretion of the bile, and the hepatic artery aſſiſts while, perhaps, it performs other offices, by no means underſtood. Anatomiſts and phyſiologiſts are apt to get into a train of accounting for things without reflection. The hepatic artery has been ſaid as ſerving to nouriſh the liver. Now, how does it appear that the vena portarum cannot nouriſh it? All thoſe that admit of the nouriſhment being conveyed by arteries, admit that the cæliac and both meſenteric arteries can nouriſh the ſtomach, pancreas, guts, and ſpleen, how is the blood ſo deprived of nouriſhing matter that it cannot furniſh enough to the liver? It is taken for granted, rather than proved, and we have by no means an abſolute proof that it does ſerve this purpoſe; only from comparing the heart, lungs, &c. we find that blood, by having undergone one circulation, is deprived of ſomewhat material to us. Thus however great the quantity, that the whole maſs in the lungs is not ſufficient to perform certain purpoſes, unleſs ſomewhat is added by the bronchial artery, ſo that the hepatic artery may ſerve ſimilar purpoſes to the liver, and one of theſe may be nutrition: but we do not prove this with certainty, far leſs that it is the only purpoſe.

XXVII.

From the fecretion within the liver, it falls next to be determined whence the bile in the gall bladder is furnifhed. It is commonly taught, that the gall bladder receives its bile from the liver through the hepatic, and afterwards through the cyftic duct, *i. e.* it defcends by the hepatic duct, meets with more refiftance in paffing into the duodenum, in the empty ftate of the gall bladder, than to its regurgitation into the bladder. So, where there is any confiderable refiftance by aliment or wind within the duodenum, and the gall bladder is not fully diftended, the bile paffes upwards, to be lodged there for a certain time, and after remaining there it is pufhed down, either by the preffure of the ftomach, or action of the external parts of the diaphragm and abdominal mufcles, or by a fuppofed action of its own coats, through the cyftic and through the common duct into the cavity of the inteftines; or that the cyftic and hepatic bile have the fame origin, and only differ in confiftence, for by the ftagnation, changes are made, the thinner parts are taken away by the abforbent veffels; but there may be, befides, other changes made in confequence of the ftagnation, inteftine changes which we cannot fo clearly point out.

XXVIII.

Another opinion ſuppoſes, that either the coats of the gall bladder furniſhed the cyſtic bile, or that the gall bladder receives it by particular ſmall ducts opening directly into it. This opinion was ſuggeſted by Dr. Albinus, that the cyſtic bile was derived from the coats of the bladder; and he has mentioned ſeveral circumſtances that ſeem, at firſt ſight, to prove it. Thus, upon the inner part of the gall bladder, when ſlit open, we find minute follicles, which are ſuppoſed to contain the bile, and that in them it acquires its toughneſs and greater viſcidity, juſt as in the throat and alimentary canal, the mucus is inſpiſſated. A very great difference is alſo obſerved in many animals, in their conſiſtence and properties, as in birds, where the bile of the liver has a ſweet taſte, while that in the bladder is intenſely bitter, ſo that there ſeems ſome very eſſential difference; and it is farther found, that the cyſtic and hepatic ducts run parallel to each other, and open ſeparately into the cavity of the inteſtines, which is likewiſe a fact, without any communication in their courſe downwards. Beſides this, caſes are deſcribed where the cyſtic duct was found obſtructed by calculi, and yet a conſiderable quantity of bile was found diſtending the gall bladder.

XXIX.

Now to ſhew that, with all theſe appearances of probability, this notion is deſtitute of foundation, it may be obſerved that theſe follicles are indeed in the gall bladder, but they are alſo every where in the other ducts, and they are particularly numerous in the ductus communis; and when we examine the contents, we find a clear mucous matter within the follicles. So that they are merely intended for a defence againſt an acrid matter, juſt as the bladder is covered with a quantity of ſlime, which, in ſome diſeaſes, is diſcharged in great abundance. With regard to the two, they agree in colour; and, by inſpiſſating the hepatic bile, we imitate the cyſtic. So that all the changes may be accounted for from the effect of ſtagnation and abſorption.

XXX.

With regard to birds, upon blowing into the hepatic duct upwards towards the liver, we inflate the gall bladder, there are large branches ſent off to the gall bladder, there are hepato-cyſtic ducts from the branches of the hepatic ducts. And where the gall bladder has been diſtended with bile, and yet a ſtone found, the ſtone has been moveable, and the bile paſſed the ſides of the ſtone; and the ſtone being preſſed down into the duct, acted as a valve, juſt as a cork within a bottle ſtops the liquor before it is

poured out of it: and a vaſt number of caſes can be pointed out, where the cyſtic duct being totally obſtructed, by a ſtone immediately put into it, the gall bladder was found empty, the ſides almoſt contiguous and quite flaccid; and a ſingle inſtance of this kind is deciſive, becauſe, were the opinion juſt in conſequence of the impaction, the bladder ſhould neceſſarily be found diſtended with bile; and, upon tying the cyſtic duct after 20 or 30 hours, it has been found more empty than at the time of the experiment.

XXXI.

The ſame arguments refute another ſuppoſition, the applying to men the analogy of birds or the having the hepato-cyſtic-ducts, whilſt it is admitted that ſome portion of the bile may come through the cyſtic duct, it is alleged that a principal ſupply is from the liver directly into it; and ſome have pretended to deſcribe theſe ducts, and probably from what ſeemed a real obſervation, for conſiderable branches of the hepatic duct run about the gall bladder, which are more ſuperficial in that place than in any other, the gall bladder ſerving as a defence to the ducts. But wherever we find ſuch ducts, there is no communication between the trunks; the hepato-cyſtic ducts ſerve the purpoſe of this joining; and where theſe are found, there may be ſome further communication.

XXXII.

But to refute fuch opinions by direct facts, the hepatic duct may be injected without a drop entering the gall bladder; and the gall bladder may be opened, cleaned in its inner coat, and the liver then fqueezed without finding a drop poured out; and when the cyftic duct is completely ftopped or tied, the gall bladder remains empty. So we may confider it as a point eftablifhed in phyfiology, that the bile defcends from the liver by the hepatic duct, and paffes by the cyftic into the gall bladder, and returns again through the fame channel. And there is no improbability in the flow being different at different times.

XXXIII.

Chemical Analyfis of the Liver.

The fecretion of the liver, or the bile, is one of the moft important in the animal fyftem, and it is of two kinds, the hepatic and cyftic, or that forced directly from the organ into the duodenum, and that which paffes into the gall bladder, and is there allowed to accumulate.

1. The hepatic bile is thin, of a faint yellow colour, inodorous, and but flightly bitter, as is perceptible on eating the liver of animals.

2. The cyftic bile is thick, of a deeper colour, more acrid, and bitter to the tafte.

3. The proper colour of the bile is a yellowifh green, of a foapy or oily confiftence, refembling in its frothi-

neſs, on agitation, a ſolution of ſoap and water. In its taſte it is leſs bitter than that of animals.

4. The principles of the bile detected by chemiſtry, conſiſt of,

a. Water, in a great proportion.

b. Albumen, as precipitated by alcohol and mineral acids.

c. Reſin, as detected by the ſolution of bile, and its evaporation.

d. A colouring principle contained in the reſin.

e. Soda, in a cauſtic ſtate, forming neutral ſalts, with acids.

f. Phoſphorated calx, with a ſmall portion of iron and culinary ſalt.

5. The bile has been conſidered as an animal ſoap, yet it differs from it in ſome leading particulars, for it neither diſſolves oil, nor mixes with water like ſoap.

6. Bile is very ſubject to putrefaction, unleſs reduced to the ſtate of an extract.

7. This ſecretion has been conſidered as the blood deprived of its oxygen, and it is confirmed by an experiment of coagulating two parts of blood with one of diſtilled water by fire, when the filtered liquor reſembles bile; and the ſame effect follows the boiling of blood with fuming ſpirit of nitre, inſtead of water.

8. The primary uſe of the bile ſeems, 1. The extrication of chyle from the chyme, as ſent into the duodenum. 2. The exciting the periſtaltic motion of the inteſtines. 3. Imparting the yellow colour to the fœces; and 4. Preventing accumulation of mucus, and diſengaged acid in the primæ viæ.

Anatomical Preparation of the Liver.

A corroded preparation of the liver is the beſt mode of ſhewing its ſtructure; and, in order to do it completely, it requires four pipes, and as many different coloured injections. The veſſels by which this organ are injected, are the hepatic artery coming off from the cæliac, the vena portarum, the vena cava aſcendens, and the hepatic duct, through which the bile is conveyed. The vena cava on the ſuperior ſurface of the liver, ſhould be ſecured by a ligature after the blood is waſhed out as clean as poſſible. The injection is then to be made in the uſual manner, and when finiſhed, the pipes are to be removed, and the liver put into the acid liquor for corroſion before the injection becomes cold and brittle, and it ſhould never be handled till it is perfectly corroded, Then let it be waſhed clean, and when dry, varniſhed.

XXXIV.

Spleen.

After the liver, the next organ that falls to be examined is the ſpleen; which is a ſoft vaſcular body, of a purple colour. In its ſhape it is long and oval, of a conſiderable ſize, and occupying a ſpace immediately under the diaphragm, or the left ſide of the ſtomach near the ribs, and above the left kidney.

XXXV.

The ſituation of the ſpleen, however, is ſubject to ſome variety from two circumſtances, the ſtate of reſpiration, and the dilatation or empti-

nefs of the ftomach; for it rifes or falls with the dilatation of the lungs, and its obliquity is greater or lefs according to the diftenfion of the ftomach.

XXXVI.

The external furface of this organ is convex and uniform, correfponding to the furface of the ribs, to which it is oppofed; while internally towards the fpine, it is irregularly concave. In fize, the fpleen is about 5 or 6 inches long, 3 broad, and 1 thick. Its anterior part is more concave than the pofterior one, and anfwers to the convexity of the ftomach. Deep fiffures are obfervable in different parts of its edges, and it is not uncommon to have a fmaller fpleen connected with the large one.

XXXVII.

The connections of the fpleen are numerous. Below, it is fixed to the omentum, and the omentum and blood veffels join it again to the ftomach. Behind, it is connected above to the diaphragm; and below, through the intervention of the peritonæum and intermediate cellular membrane to the left kidney and colon.

XXXVIII.

The fubftance of this organ is uncommonly foft, and by far the moft tender of the abdominal bowels. It poffeffes two layers or coverings, one the peritonæal coat, the other proper to itfelf, but

closely joined to the former covering. When the subſtance of the organ is examined, it ſeems a congeries of vaſcular parts united by cellular matter, and the extremities of its veſſels terminate in penicelli or ſmall bruſhes, ſomewhat ſimilar in appearance to glands. So delicate is the ſtructure of its veſſels, that any injection of it made, is found to extravaſate into its cellular membrane, and to give its ſtructure a follicular appearance.

XXXIX.

In proportion to its ſize, the veſſels of the ſpleen are larger than thoſe of any other organ. Its artery is a principal branch of the cæliac, and is one of the moſt remarkable in the body. It is as large as a gooſe quill. It proceeds from the cæliac trunk at right angles, and runs a foot in length acroſs to reach the ſpleen. In this courſe it obſerves a ſerpentine direction; and, after ſending off branches to the pancreas, and the arteriæ breves to the left end of the ſtomach, it goes into the ſubſtance of the ſpleen, dividing into a great many branches which enter by the concave ſurface of the organ, and plunge deep into its ſubſtance.

XL.

The firſt of the branches of the ſplenic artery thus deſcribed, is the pancreatica magna, which paſſes to the right under the pancreas, and belongs chiefly to its rounded end, under the duodenum.

2. By the border of the pancreas to the left, it fends alfo fhort branches into that organ.

3. Next, its branches afcend to the back part of the ftomach, and its very large and principal one, is the gaftro epiploic artery. It arifes under the ftomach, beyond the head of the pancreas, makes a ferpentine arch, turning upon the ftomach, and fending branches up to it, and down upon the omentum.

4. Laft of all, the vafa brevia are given off to the ftomach before it enters the fpleen.

XLI.

The fplenic artery then entering the fpleen, is fubdivided into branches, which are crowded together, and run in every direction, forming at length plexus or penicelli, which terminate in the branches of the correfponding vein. This vein is larger in proportion than the artery. It is much ramified, and carried through the whole of the organ. It receives the blood without the intervention of cells, and into it flow the contents of the vena brevis, of the ftomach, veins of the pancreas, &c. fo that it forms a chief branch of the vena portæ.

XLII.

From the fpleen, no excretory duct has been found to proceed, which has rendered the ufe of this organ ambiguous. It appears, however, from

the termination of its veſſels on the vena portæ, that it has a connection with the ſecretion of the liver, and that it diſpoſes the blood collected in the vena portæ, to be more eaſily formed into that ſecretion.

XLIII.

The ſpleen thus appears like a clot of blood incloſed in a membrane of no greater thickneſs or toughneſs. We find arteries in great number conveying a great proportion of blood into the ſubſtance of it, and there divided into very minute branches. In like manner, there are a number of very minute branches of veins, joining together to form larger veins, and forming a trunk, terminating in the vena portarum. In the human body there is no intervention of cells, which are only ſeen when an injection is thrown in with too great force, in which caſe there is an extravaſation into the cellular membrane. Neither do we obſerve knots that may be called glandulæ, or any ducts or hollow tubes ſent out, except the red veins and common lymphatic veſſels.

XLIV.

What account, therefore, is to be given of the ſpleen? This may be judged of from the want of particular ducts, that we can only form con-

jectures about it; and the variety of opinions advanced, plainly prove the uncertainty of all of them; and indeed moſt of them are ſuch as ſcarcely merit attention.

XLV.

A late opinion concerning the ſpleen forming the red part of the blood, cannot even be excepted; ſo that there is nothing fixed or determined concerning the uſe of the ſpleen, further than a general preſumption that it is ſubſervient to the liver. For let us ſee what kind of notion we can have of the ſpleen forming the red part of the blood. We obſerve a very great quantity of red blood entering the ſpleen. Surely that can be no argument for its forming the blood? It is formed before it enters; and the only foundation for the opinion is, that red particles are obſervable in the lymphatic veſſels, when theſe are tied up. But the ſpleen has been cut from animals, they have ſurvived the operation, days, months, and years, and the colour of the blood has remained all the while the ſame. How is this to be explained? That the lymphatic veſſels of the ſpleen chiefly convey the red parts, but that the whole lymphatic ſyſtem contributes in the ſame office. So far ſuch an hypotheſis may be commended as ſerving for a retreat, but what are

we to think of it? That the veſſels by nature intended for abſorbing the colourleſs part of the blood, which in a ſound animal convey only the colourleſs parts, are to be ſuppoſed to form the red globules. There is certainly an improbability in it, to ſuppoſe that lymphatics that take in a fluid from the ſurface of the ſkin, ſhall change its nature, and convert it into red. Why lay the burden upon that part of the ſyſtem called lymphatic? Why have recourſe to more than the firſt beginnings of the lacteals, and to ſuppoſe that the food may be ſo converted? But, to ſhew the abſurdity of ſuch opinions, we find that the experiment ſucceeds in the ſame way in whatever organ of the body it is made. We know from a great number of experiments, that wherever we let in air upon the ſenſible and deep ſeated organs, whether we tie up the lymphatic veſſels or not, we ſhall find red parts conveyed through every lymphatic veſſel, becauſe from the irritation of the air ſuch an inflammation is produced as gives occaſion to the effuſion of the red parts, which are again taken up by the abſorbent ſyſtem.

XLVI.

But, further, if the ſpleen was intended for the formation of the red blood, why is the blood

ſent from it into the liver? Why, after performing its office, does it not return in its ſhorteſt road into the vena cava.

XLVII.

We may ſay that the bile is thrown in to break the force of the blood, as it is in the ſecond circulation that the bile is beſt formed. But in the herbivorous animals, where the tract is longer, and more blood diſperſed upon the alimentary canal, we ſtill find a ſpleen: ſo that it would appear that ſome change, which we perhaps ſhall never be able to aſcertain abſolutely, is produced on the blood in its paſſage through the ſpleen, ſuch as fits it for the ſeparation of the bile. Or there is the ſtrongeſt reaſon to believe that it is ſubſervient to the liver, though with regard to the manner, we ſhall perhaps never be able fully to underſtand it. From experiments that have been made by cutting out the ſpleen, and obſerving the changes made upon the bile, we can yet conclude nothing certain, and we can draw the moſt general concluſions only, that it is conſtant in all animals in which bile is ſecreted; and in all, the blood enters from it into the vena portarum, which is the principal organ ſerving for the ſeparation of the bile.

XLVIII.

Anatomical Preparation of the Spleen.

As the texture of this organ is ſo ſoon broken down, it muſt be procured for injection in the moſt recent ſtate. It is to be injected only by the artery and vein, ſince it poſſeſſes no excretory duct; and, if the organ is freſh, the extremities of the veins will appear uniformly rounded. The after treatment is to be conducted in the ſame manner as deſcribed in the liver.

XLIX.

Pancreas.

The pancreas is a long flat gland of the conglomerate kind. It is ſituated in the epigaſtric region, and placed tranſverſely on the back part of the abdomen, between the ſtomach and ſpine. In its ſhape it is ſaid to reſemble much the tongue of a dog, and it poſſeſſes an elongation or proceſs from one of its extremities, which adheres cloſely to the duodenum, and is termed its head.

L.

In deſcribing more particularly its ſituation, the body of the pancreas paſſes before the upper part of the tranſverſe portion of the duodenum, and over the aorta, vena cava, and part of the ſplenic veſſels, to all of which it is attached; and through the intervention of the omentum, one end of it alſo is fixed to the ſpleen. Its membranes are derived from the meſocolon, and conſiſt of two layers.

LI.

The ſtructure of the pancreas conſiſts of acini, which unite to form ſmall glands or lobes. A quantity of cellular ſubſtance looſely connects them, ſo that an external appearance of ſmoothneſs and uniformity is afforded. The circulation of the pancreas has been already detailed in that of the preceding organs, its arteries ariſing from the hepatic and ſplenic by ſeveral branches which paſs into its ſubſtance in different places, and chiefly in a tranſverſe direction. Its veins obſerve the ſame name and courſe as its arteries, and terminate in the vena portæ.

LII.

From the different acini of this organ, ſmall ducts ariſe which unite and form larger ones, and in their courſe they obſerve a tranſverſe direction. They at laſt meet in one common duct, termed the pancreatic duct.

LIII.

The pancreatic duct begins at the left extremity of the pancreas, and runs in the ſubſtance of the gland, a little below its middle, gradually enlarging in ſize in its courſe in conſequence of the different branches joining it, till at laſt it is found equal to a ſmall quill. At the right extremity of the organ it receives the duct of the elongation or proceſs, and it then terminates ob-

liquely in the duodenum, along with the ductus communis choledochus, though the place of this termination varies a little at times.

LIV.

The use of the pancreas is clearly to secrete a fluid of a salivary nature, which is poured into the intestines.

LV.

To sum up our opinion of this organ, we observe, that it is the principal salivary gland. There is a sameness of colour, a similar division into lobes, the coats of the ducts thin and transparent, very much resemble the coats of the inferior maxiliary gland, and sometimes concretions form within the ducts, resembling some of the other salivary concretions, and they agree perfectly in colour and consistence. One farther resemblance may be pointed out, that mercury affects these glands in like manner as the salivary glands are affected; and it is suspected that the diarrhœa which mercury produces, is very much owing to an increased discharge from the pancreas; and, when a pipe is fixed into the duct of the pancreas, a liquor like the saliva is discharged from it.

LVI.

The arteries of the pancreas come from the splenic arteries, nearly at right angles; and it happens that all the salivary glands are supplied

with arteries much in the ſame manner: ſo that the direction no ways correſponds to the effect of mercury upon them, which was ſuppoſed to be thrown into the arch of the aorta towards the head, and to be determined into theſe glands by the direction of the arteries, and the pancreas was overlooked. But it is evident that the effect of mercury here is to be explained upon the very ſame principles as the ſecretion of the ſaliva. Why do theſe glands ſeparate ſpittle? Whoever ſhall explain this, will be better able to explain the other. They both depend upon a particular organization, upon minute circumſtances in the ultimate diviſion of the veſſels, and ſenſibility of the nerves, circumſtances that altogether eſcape us; ſo, till we explain this, it is in vain to ſpeak of the other.

LVII.

Chemical Analyſis of the Pancreatic Juice.

The quantity of pancreatic juice ſecreted, ſeems equal to three times the quantity of ſaliva; and, by chemical examination, the nature of the ſaliva and this ſecretion are found to correſpond, as far as can be judged from ſmell, taſte, colour, and conſiſtence.

Analyſis of Contents of the Chylopoetic Viſcera.

Having now demonſtrated the chylopoetic viſcera, and their aſſiſtant organs, which pour their different ſecretions into them, it is proper to examine chemically

their contents, consisting of the chyme, chyle, and fœces.

Chyme.

Chyme is the product of the undigested food in the stomach. It is of a cineritious or yellow colour, and of a pultaceous soft consistence. From the nature of vegetable and animal matter, as food, its principles most consist of;

1. The alible parts of such matter reduced into a pulp, or a soft mass.

2. Those parts of it which remain undecomposible.

3. A union of saliva, gastric fluid, and mucus along with them.

In this state it must pass from the stomach into the small intestines.

Chyle.

The chyme in the small intestines is separated into two parts, chyle and fœces.

The chyle is a whitish liquor, of a sweet taste. It much resembles milk, but is of a thinner consistence; and its resemblance to milk appears still stronger when it is more fully examined.

The quantity of chyle depends much on the nature of the food, but from 5 or 6 lbs., little more than $\frac{1}{3}$ of this product is elaborated.

The constituent principles of chyle are much the same with those of milk, consisting of a serous, oily, and coagulable part. Thus there is obtained from it;

1. Water, which is its greatest proportion.

2. Oily cream, a combination of hydrogen and carbon.

3. Cheefe, or coagulum, formed from the carbon and azote of the food.

4. Earth, for calculi, are found in the thoracic duct and lacteals.

5. Animal lymph, as mixt with the juices of the inteftines.

From this view, chyle feems milk in a preparatory ftate, or poffeffing lefs of the coagulable or animal principle, which becomes perfected on its entering the thoracic duct, from its mixture with the contents of the lymphatics poured in here.

Fœces.

The fœces are a yellow or brown mafs of various confiftence in different parts of the inteftines, and expelled in a form moulded by that of the part they pafs through. They confift of the undigefted part of the aliment mixed with the bile and fecretion of the inteftines. They poffefs a difagreeable and peculiar odor, differing in different animals. They firft appear in the cæcum, and are faid to difcover a fweet tafte. Their quantity, daily, is not lefs than 4 or 5 oz., but this is regulated by the food, vegetable food affording a larger proportion than animal food.

The conftituent principles of the fœces are;

1. Water, for diftillation, reduces them to $\frac{1}{10}$ of their weight.

2. A fœtid principle affecting the noftrils.

3. Inflammable carbonated air, which, on being fet on fire, burns with a bluifh green flame.

4. The indigefted remains of the food, which the bowels cannot act upon; and

5. The mixture of inteſtinal excretions, viz. bile, enteric and pancreatic juice, mucus, &c.

From this view, the ſaliva and gaſtric juice in the ſtomach make the preparatory change on the food by converting it into chyme, or give it the ſeparable ſtate of its alible principles. Thus, to take an example, milk is coagulated in the ſtomach in order to ſeparate its principles as the firſt ſtep of digeſtion. In the inteſtines, the bile and pancreatic juice make the ſubſequent alteration, by uniting theſe alible principles into a fluid or chyle, and ſeparating from this fluid the indigeſtible part, or fœces; and, in the thoracic duct, this fluid or chyle is perfected by its mixture with lymph, or the contents of the lymphatic ſyſtem. From the thoracic duct it next paſſes into the general circulation, where the proceſs of reſpiration, as already noticed, beſtows on it the perfect animalized ſtate.

Lymph, then, would ſeem the fundamental preparatory menſtruum which is kept ready by the ſyſtem to be poured out in a variety of places, as the aliment deſcends in order to be united with it; for we find, on examination, that the ſaliva and pancreatic juice, and that the lymph, as far as we can judge by examination, agrees with each other in their nature.

The exact quantity of the excretions for the purpoſes of digeſtion and chylification, it is difficult to determine. For each meal, it is computed there is 6oz. of ſaliva; of bile, from the ſize of the liver, that there is not leſs than 24 oz.; and of pancreatic juice, there is 3 oz. The weight of theſe organs is rated at 3 lbs.

12 oz. to the liver, 3 oz. to the pancreas, and 14 oz. to the ſpleen. The flow of bile from the liver is greateſt when the ſtomach is diſtended from the preſſure of the organ againſt the ſtomach, and the reverſe of this takes place with reſpect to the gall bladder, which has its fluid preſſed out by the diſtenſion of the duodenum.

Thus the bile is the menſtruum that, by its combination, ſeparates the chyle and fœces, prevents the abſorption of the latter along with the former; and, by its irritation of the inteſtinal canal, haſtens its exit from the body.

During theſe proceſſes going on in the ſtomach and inteſtines, theſe organs are never deſtitute of the preſence of gaſes. In health, the quantity is ſmall, but they are accumulated by diſeaſe.

Gaſtric air, when examined, has been found to conſiſt of a mixture of four different kinds.

1. Carbonic acid gas, which is moſt in the ſtomach, and in ſmall quantity in the inteſtines.

2. Vital air, contained chiefly in the ſtomach and inteſtines.

3. Azote, and carbonated inflammable air, contained in the large inteſtines.

As the preſence, then, of the carbonic gas and vital air is greateſt in the ſtomach and ſmall inteſtines, ſo theſe gaſes are the fundamental principles of the chyle. Thus carbon, united with hydrogen, forms the oily or creamy part; and carbon, with azote, the cheeſy or coagulable part.

LVIII.

From the moveable, which we have now examined, we proceed next to what are termed the fixed viſcera of the abdomen; the firſt of which is the kidneys.

LIX.

The kidneys are two glandular bodies, of a pale red colour, ſituated on each ſide of the vertebræ of the loins, on the poſterior part of the abdomen, upon the two laſt ribs. The right kidney lies under the great lobe of the liver, and is conſequently lower than the left one, which lies under the ſpleen. The concave ſide of the kidneys is turned inwards to the vertebræ, and the convex ſide outwards.

LX.

The kidneys poſſeſs numerous connections. The right one is attached to the liver and duodenum by means of cellular ſubſtance, and its peritonæal covering. The left one is connected to the ſpleen by the ſame means, while both are united to the muſcles on which they are placed, and alſo to the renal glands and colon. From theſe connections, they accompany the motions of the liver and ſpleen in the different ſtates of reſpiration.

LXI.

The ſize of the kidneys is about five or ſix fingers' breadth in length; but it is conſiderably

leſs from the outer to the inner ſide, and ſtill leſs from before backwards. Hence it has been compared to a kidney bean. The diſpoſition of the veſſels diſtinguiſhes the right kidney from the left when taken out of the body.

LXII.

Each kidney is ſurrounded by a covering of looſe cellular membrane, within which is contained a conſiderable quantity of fat; and this covering inveſts both the kidney itſelf, and alſo its large veſſels, ſo as to defend them from the preſſure of the ſurrounding organs. On the removal of this covering, the proper coat of the kidney appears, conſiſting of two layers, its proper membrane, and condenſed cellular matter, which form a ſtrong adheſion to it, and are reflected over the edges of the ſinus, to be joined to its pelvis and large veſſels.

LXIII.

The ſubſtance of the kidney is commonly deſcribed as ſmooth and uniform; and where an irregularity takes place, it is in conſequence of its original lobes not properly incorporating. It is divided into two parts, a cortical or external part, and a medullary or internal.

LXIV.

The cortical, or ſecreting part of the kidney, ſurrounds it ſo as to form a third of its breadth;

and, by its proceſſes, or partitions, the medullary parts are ſeparted from each other. The medullary, or uriniferous part of the kidney, is diſtinguiſhed by its redneſs and diſtinct columns; and theſe columns terminate in its papillæ, or mammilary proceſſes. Theſe papillæ are connected to each other by cellular membrane; they form a continuation of the uriniferous part; their number is uncertain, amounting from eight to ſeventeen, and depending on the number of original lobes of which the kidney is compoſed, and alſo on the incorporation of ſome of the papillæ with each other. The points of the papillæ compoſe the terminations of the uriniferous tubes; and theſe terminations through which the urine diſtills, are diſtinct to the eye. From the root of each papilla originates a membranous tube, termed the infundibulum, to receive the diſcharge. The number of theſe tubes correſpond with the papillæ, unleſs where more than one papilla opens into the ſame tube.

LXV.

In their progreſs, theſe tubes, or infundibula, unite into larger trunks, two or three in number; and by the expanſion of theſe trunks, a cavity of conſiderable ſize is formed, anſwering to the ſhape of an inverted cone, and conſtituting the pelvis of the kidney. In point of ſituation, the pelvis is, for the greater part, without the body

of the kidney; it contracts at laſt into a long tube, diſtinguiſhed by the name of the ureter. One of theſe tubes is appropriated to each kidney: but they have been occaſionally met with double in one or both kidneys. In their deſcent, the ureters paſs obliquely behind the peritonæum; and this obliquity is alſo obſerved in their inſertion into the bladder, which hinders the return of the urine from them. In their paſſage downwards, the ureters go over the great pſoas muſcles and iliac veſſels, at the fore and lateral parts of the ſacrum. Their termination is in the under, outer, and back part of the bladder.

LXVI.

Theſe tubes, in the courſe of their deſcent, have been compared to the letter ſ; and they occaſionally ſuffer dilatations and contractions, which occaſion ſome change of their cylindrical ſhape. Theſe contractions occur chiefly in their courſe over the pſoas muſcles, and their inſertion into the bladder. The ſtructure of the ureters is formed by three coats. The firſt is ſimply a peritonæal covering; the ſecond is of a muſcular nature, and formed chiefly of circular fibres; and the third, or internal, is villous, conſiſting of veſſels and ſmall excretory ducts, ſupplying a diſcharge of mucus to defend their ſurface from the urine.

LXVII.

The circulation of the kidneys requires next to be traced. Each kidney poſſeſſes one or more arteries derived from the aorta, and the correſponding vein or veins terminate in the cava. The entrance of its veſſels into the kidney takes place at its ſinus, and they are enveloped in a cellular ſubſtance during their courſe. Of the arteries, the right one is longer than the left, from the circumſtance of the vena cava being placed at the right ſide of the aorta.

LXVIII.

In its approach to the kidney, a diviſion of the artery takes place into branches, which are extended to extreme minuteneſs through the cortical ſubſtance in the form of arches and anaſtomoſes; and the termination of this diſtribution of them, after various turnings and windings, is partly on the ſurface of the kidney, when they aſſume an irregular ſtar-like form, and partly internally, where they paſs in a waving direction, and aſſume an appearance ſomewhat ſimilar to cluſters of ſmall berries, viſible only by injection, or the aſſiſtance of glaſſes, and termed in this form, corpuſcles.

LXIX.

In the ſame manner the veins, on their return from their arterial extremities, unite in the cor-

tical ſubſtance of the kidney; and the branches of the vein, though they correſpond with the artery in their courſe, are much larger. They terminate on each ſide in a trunk, which enters the cava in a tranſverſe direction; and the left vein is the largeſt of the two.

LXX.

From the extreme arteries, or corpuſcules, the uriniferous tubes take their origin, already deſcribed as ſeated in the cortical ſubſtance: they form with their ſmall vaſcular congeries the medullary portion of the organ. In their courſe they unite into larger tubes, which aſſume in their paſſage a radiated form, or run from the outer to the inner part of the cavity, and at laſt extending in their ſize, they terminate in the conical papillæ already deſcribed.

LXXI.

Renal Capſules.

Above the renal veſſels are ſituated the appendages of the kidneys, or what are termed the renal glands. They are two ſmall flat bodies, of a dark yellow colour. In their appearance they are glandular, and lie over the upper and fore part of the kidneys. Their figure is irregular; their length about two inches: but their ſize is greater in proportion in the fœtus than in the adult.

LXXII.

Thefe bodies are inveloped in cellular fubftance fimilar to the covering of the kidney, and, like it, they poffefs alfo a proper coat of a thin texture, and firmly adhering to it. Their connections to the contiguous parts are numerous. The right one joins the liver, the left one the fpleen and pancreas; and, by the intervention of cellular fubftance, they are both attached to the diaphragm, the pfoas mufcles, and kidney. In their ftructure, thefe glands are frequently found hollow, and they contain a dark-coloured or bilious matter. Their circulation is fupplied by the adjacent organs; their arteries from the renal aorta and diaphragmatics; and their veins terminate, the right one in the cava, and the left one in the renal vein.

LXXIII.

The ufe of the kidneys is evident by their fecretion: but the ufe of the renal glands is ftill undifcovered, and has given rife to various conjectures. From their particular fituation, it is probable they are fubfervient in their office to the kidney, in the fame manner as the fpleen is to the liver, and the pancreas to the parotids.

LXXIV.

Bladder of the Urine.

The termination of the ureters we found to be in the bladder of the urine, which is a large bag, ſituated in the pelvis, or at the bottom of the hypogaſtric region. This organ, when empty, contracts to a ſmall ſize, and occupies ſimply the under and fore part of the pelvis; but, on its diſtenſion, it riſes above its brim, and ſometimes aſcends to nearly the height of the navel. The figure of the bladder varies according to the degree of its dilatation. When moderately diſtended, it diſplays an irregular oblong form, more capacious below than above.

LXXV.

This organ is divided into three parts; its fundus, its body, and its neck. The ſituation of the firſt being upwards and forwards; and of the laſt, at its fore and under part.

LXXVI.

The attachments of the bladder are numerous to all the ſurrounding parts. Below, it is connected with the rectum. The peritonæum, and cellular ſubſtance, join it laterally to the pelvis in the form of ligaments. To the pubes it is attached by cellular ſubſtance alone; to the umbilicus it is fixed by the remains of the umbilical veſſels, and the urachus running up from its ſubſtance.

But its firmeſt connection is a ligamentous expanſion running on each ſide of its neck, and fixing it to the internal arch of the pubes, where the urethra alſo connects it to the penis.

LXXVII.

The bladder, like the other organs, poſſeſſes ſeveral coverings connected by cellular matter. The firſt is its peritonæal coat, paſſing from the abdominal muſcles to it; and, when the bladder is much diſtended, from its connection with the peritonæum, it carries it with it, leaving a ſpace between that membrane and the pubes.

LXXVIII.

The ſecond, or its muſcular one, is the moſt important coat of the bladder. It is formed of fleſhy fibres, ſo interwoven as to form faſciculi. The external diviſion of theſe fibres obſerves a longitudinal direction, and is connected at its under and fore part with the bones of the pubes; but, internally, its fibres form a net-work, and obſerve no particular direction. At the neck of the bladder, theſe fibres, by their contraction, form the ſphincter. It is by the action of this coat that the diſcharge of the bladder takes place; and, by the ſeparate action of the fibres of the neck from the fundus, an involuntary emiſſion of the urine is prevented.

LXXIX.

Between the muſcular and inner coat, the intervening cellular coat has been often conſidered as a diſtinct one; but for this there is no proper foundation.

LXXX.

The inner coat, or, as it is termed, the villous one, is a thin and ſmooth covering, ſomewhat unequal by the projection of the muſcular fibres, and formed into rugæ when the organ is empty. This coat is poſſeſſed of much irritability; and the irritation of the urine excites it ſtrongly at times to act. Hence, to guard againſt the diſcharge, it poſſeſſes a mucous ſecretion to blunt its acrimony, ſo as to prevent its being ſtimulated for the moſt part till the diſtenſion of the organ alſo co-operate.

LXXXI.

At its under part, the bladder is perforated in three different places. The anterior perforation is the commencement of the urethra, being ſurrounded by the neck of the bladder, and coming off at a right angle from its under part. The two other openings are ſituated behind, and form the terminations of the ureters. They are placed at a little diſtance from each other, and obſerve an equal diſtance feom the beginning of the urethra as they do the one from the other. Their opening is ſomewhat of an oval form, and

more contracted than the ſpace of the ureter immediately above.

LXXXII.

The circulation of the bladder is ſupplied from various ſources. Its arteries are chiefly from the umbilical and pudenda communis, and its veins terminate in the internal iliacs, which form a plexus of conſiderable ſize on each ſide of the bladder.

LXXXIII.

The ſecretion from the kidney is tranſmitted to the bladder through the ureters by drops, or ſmall thread-like ſtreams; and, when accumulated, the quantity and acrimony of the ſecretion forces the organ to contract in order to expell it. In doing this, the action of the organ itſelf is alſo aſſiſted by the abdominal muſcles and diaphragm preſſing the bowels againſt the organ. The frequency of this operation depends on a variety of circumſtances, as the ſize of the bladder, its degree of ſenſibility, the quantity of the urine, and its irritating quality.

LXXXIV.

From this view of the urinary organs, the kidney appears defended by a quantity of fat from the preſſure of the abdominal viſcera, and by the like means it is defended from the lumbar vertebræ, which lie behind, the tunica adipoſa being upon the back part as well as the fore.

There is next a proper membrane, not derived from the peritonæum, connecting the ſeveral lobes that is found in the fœtus, and it is in a conſiderable degree formed of cellular ſubſtance condenſed, but not entirely, for the inner ſide of it has the ſame ſmoothneſs as a portion of the peritonæum. When the kidney is cut into, two ſubſtances are obſervable. Firſt, the cortical glandular, or vaſcular part. From this part tubes are ſent inwards; and as they are collected from the whole ſurface, they give the cortical appearance. At their end we find the papillæ, from which the urine is diſcharged into the pelvis of the kidney; and the papillæ project into the kidney, to give room for more ducts, and alſo that the urine may not regurgitate, or be puſhed back into the maſs of blood; ſo that the more the pelvis of the kidney is diſtended, the ſides of the papillæ are the more compreſſed.

LXXXV.

As the kidney is originally compoſed of a number of different lobes, there appear many infundibula uniting into one common duct, like branches of veins collected, and there is no certain rule, with regard to the number, or manner of joining; in ſome infundibula there is a ſingle papilla, and in ſome two, &c. and alſo the number of infundibula varies.

LXXXVI.

From the pelvis of the kidney, the urine paſſes down to the ureter, where it gets the conical ſhape from the number of canals forming it. Thus ſtones may more readily form here, and where they do, they may not get down through the narrow ureter, but may remain in the kidney. The ureter is not entirely cylindrical, but varies in its ſize, and that in different places, for which no cauſe can be aſſigned, except at the turn where it gets into the pelvis; and this explains the various motions of a ſtone in the ureter. At the lower end, it paſſes ſo obliquely into the bladder as to ſerve the place of a valve, and at the ſame time the mouth is contracted, ſo that a ſtone may readily be interrupted at its entrance; this in women gives room for an operation, by which the life of a perſon may be ſaved. The ureter has a denſe coat of the muſcular kind, and another denſe and ſmooth coat within it, and the action of the ureter may be ſeen very diſtinctly, contracting itſelf like a worm upon a very ſlight irritation. It is material to obſerve this, that it is not to be conſidered as a mere membranous tube; and in the caſe of the deſcent of a ſtone, we ſee the advantage of giving opium, for, by leſſening the pain, the ſpaſm is taken off, and the relaxation of the muſcular coat lying upon it, by which means the urine may puſh on the ſtone into the bladder.

LXXXVII.

The bladder is of a curious and complex ſtructure; and here the common opinion, with regard to the extent of muſcular contraction, is contradicted; for the bladder can contain 2lbs. of urine, and its fibres are at the ſame time capable of contracting ſo in all directions as to expel every drop of this, which ſhews that muſcular fibres poſſeſs a very extenſive power.

LXXXVIII.

Nor is there obſervable any particular muſcle ſerving as a ſpincter, and yet we poſſeſs two oppoſite powers of puſhing the urine out, and ſtopping it, at pleaſure; and hence muſcular fibres can act ſo that one part of the fibre is an antagoniſt to the other, or we can employ parts of fibres to perform an office; we can relax the one part, and employ the other; and that it can be done alternately. The internal coat of the bladder is very dilatable, ſo may be puſhed out by a ſtone, between the fibres of the muſcular coat, in which caſe there will be difficulty in extracting the ſtone.

LXXXIX.

The name of villous, applied to the inner coat of the bladder, which is ſmooth, is evidently improper. We do not find all the fibres in the muſcular coat running from the mouth of the

fundus, but many of them run obliquely; and we can only ſay, that many bundles of fibres begin at the neck, run up to the fundus, come down upon the oppoſite ſide, and croſs a little when they reach the neck; or that we find the fibres very fitly diſpoſed for contracting the bladder into all its directions. The deſcription, therefore, of a diſtinct ſpincter muſcle is improper; all that can be demonſtrated is, that the circular fibres grow a little thicker, and the longitudinal and oblique decuſſate each other, but without forming a complete circle, as is obſervable at the pylorus, or without there being any diſtinct muſcle, as we find at the extremity of the inteſtinum rectum.

XC.

Chemical Analyſis of the Urine.

The ſecretion of the kidneys, or the urine, is divided into the crude or cocted. The former being an immediate diſcharge after food or drink, and therefore copious, and occaſionally vitiated by certain impregnations; the latter thicker, more coloured, and acrid, and emitted in the morning after ſleep.

This diſcharge is of a citrine or ſtraw colour, poſſeſſes a temperature equal to the blood, is ſaltiſh and nauſeous to the taſte, and in its conſiſtence thicker than water.

Its quantity is regulated by the quantity of fluids taken in, and the ſtate of the ſeaſon.

By the uſual teſts, urine diſcovers neither an acid nor alkaline nature. By farther experiment, it is proved

entirely an aqueous, not a ferous fluid; and, by its evaporation, its chief products are compound falts.

The progrefs of urine to putrefcency, is more rapid than that of any of the other animal fluids, and its changes in the open air, in paffing to this ftate, deferve attention. On its firft difcharge, it remains pellucid for fome time; but, at laft, there appears at bottom a a fmall cloud, or marks of a confolidated gluten, which thickens and increafes till it occupies the whole veffel, and renders the urine opake. As this procefs advances, the fmell of the urine is changed, becoming putrid and cadaverous, and a cuticle is formed on the furface of the veffel, compofed of minute cryftals.

The urine next regains its tranfparency, and acquires a brown, inftead of its yellowifh colour. Its fmell alfo changes to an alkaline nature, and a brown grumous fediment is depofited at the bottom filled with white particles fubject to deliquefcence, and fo conglutinated, as to refemble foft calculi. In this ftate the urine effervefces with acids.

By evaporation of 36 oz. of urine, one ounce and a half of refiduum is procured, containing the following proportion of ingredients. Muriatic falts, 1 dram. Phofphoric falts, 3 drams, 50 grains. Uric acid, and phofphate of lime, 25 grains. Animal extractive matter, 3 drams, 40 grains.

Thus the recent urine contains an excefs of phofphoric acid, which it foon lofes for the prevalence of ammonia; but, of all its ingredients, the moft remarkable is the uric, an excrementitious fubftance furcharged with nitrogen, the excefs of which it carries off from the body.

The general conſtituent principles of the urine are ;

1. Water, in ſuch a proportion, that from 20 oz , 19 of this fluid were obtained.

2. An odorous principle, perceptible to the ſmell,

3. Phoſphorated ſoda, as aſcertained by calcination of the dry extract, and its ſolution in water.

4. Phoſphorated ammonia, which is aſcertained by allowing a ſolution of calcined extract of urine in ſpirit of wine to cryſtallize the microcoſmic ſalt of urine, is found conſiſting of ammonia, ſoda, and phoſphoric acid.

5. Calculous matter, in the form of a browniſh red earthy gluten, and conſiſting of gluten, animal earth, and uric acid, as diſplayed by the analyſis of calculi.

6. The extractive principle of urine, or uric ; and,

7. Compound ſalts ; as, muriate of potash, and muriate of ſoda.

No animal fluid is ſubject to ſo much variety as the urine, and this happens from the effect of

1. Age ; for its acrimony gradually increaſes with the progreſs of life.

2. Drink ; for cold and copious draughts render it pale ; while green tea, caſſia, pulp, render it green.

3. Food ; for aſparagus or olives give it a peculiar ſmell, and faſting renders it turbid.

4. Medicines. Thus rhubarb gives it a yellow tinge, and turpentine a violet colour.

5. Period of ſeaſon ; for, in winter it is copious and aqueous ; in ſummer, ſparing, high coloured, and acrid : an influence equally diſplayed alſo by the climate.

6. Mufcular action; for, by motion its fecretion is leffened, and increafed by reft.

7. Affections of the mind. Thus fear renders its fecretion pale.

Anatomical Preparation of the Mefentery.

In order to inject its veffel, proper care muft be taken to fecure their extremities. When this is done, one of the largeft arteries and veins near the root of the mefentery fhould be chofen, and into them proper pipes fixed, and the injection conducted with two liquors of different colours. The injection will enter every part of the mefentery and inteftines freely, in confequence of their numerous anaftomofis.

Anatomical Preparation of the Kidney.

For injection, a kidney as found as poffible fhould be chofen, and there are three orders of veffels in it to be injected in order to fhew their ramifications by corrofion. The artery here is diftinguifhable by its greater thicknefs and elafticity, and alfo by being generally fmaller than the vein; and the duct is known by its enlargement near its entrance into the kidney. Proper fized pipes then being fixed into the different veffels, proceed according to the directions given in the other organs, to fill each fet of veffels with a different coloured injection; and, after the pipes are removed, the kidney is to be immerfed in the acid folution for five or fix weeks, till the texture of every part is deftroyed, and may be wafhed off from the corroded preparation.

For the purpofes of injection, the kidney fhould be carefully removed from the body, and no part of it wounded, or any of its fat removed.

XCI.

Having now purſued the deſcending aorta, or vaſcular diſtribution through the thorax and abdomen, before examining the organs peculiar to the ſexes, or tracing the circulation of the extremities, it is proper to return and view that of the upper parts, as carried on by the aſcending aorta.

XCII.

From the arch of the aorta, which they entirely occupy, come off three great arteries that riſe to the head, or decline laterally towards the arms; and by them are nouriſhed all the upper parts of the body. The firſt of them is the right carotid and ſubclavian, formed by its diviſions above the the arch about an inch. The ſecond is the left carotid, going to the head; and the third is the left ſubclavian, going to the left arm.

XCIII.

We ſhall examine the diſtribution of the carotid artery firſt. This artery having emerged from the thorax, runs up along the neck by the ſide of the trachea, in one diviſion, till it touches the lower jaw. In this courſe it conſtantly recedes from the fore part of the throat, getting gradually deeper till protected by the projection of the larynx. It divides, at the jaw, into two branches, termed the external and internal carotids; the one going to the outſide of the head, the

other to the brain. And, in order to underſtand the circulation here, it will be neceſſary to examine firſt the general ſtructure of the ſeveral organs theſe particular veſſels are deſtined to ſupply.

XCIV.

Brain.

The firſt, and moſt important of theſe organs, next to the heart, is the brain, or origin of the nervous ſyſtem. It is that maſs which, with its incloſing coverings, fills the cavity of the cranium; and in the human ſubject, it exceeds in proportionate ſize to the brain of every other animal.

XCV.

The coverings of this part conſiſts of three membranes. The dura-mater, arachnoid coat, and pia mater.

XCVI.

Dura Mater.

The dura mater forms the external incloſure, and is the means of connecting this organ to the cranium, which it lines. Though but a ſingle membrane, it is in ſeveral places diviſible, by maceration, into layers.

XCVII.

In its texture, this membrane poſſeſſes conſiderable denſity, and may be conſidered as the thickeſt and ſtrongeſt in the body, approaching ſomewhat to tendon in the ſtrength of its fibres. Its adheſion to the ſurface of the cranium is

equally ſtrong as that of the perioſtæum to the bones elſewhere; and this adheſion is particularly firm at the ſutures and openings, or foramina, and is even ſtronger in childhood than in age. On its external ſurface it forms a ſmooth lining to the brain, only attached at the place where the veins are expanded into ſinuſes, and it is everywhere lubricated by a ſerous excretion from its veſſels.

XCVIII.

By the ſecretion of the fluid of this membrane, the different ſtates of reſpiration are prevented from injuring the organ; and, ſimilar to the perioſtæum of the bones, it forms both a defence to the brain, and conveys nouriſhment to the internal layers of the ſkull. By it, alſo, the ſituation of the brain is preſerved ſteady, and various proceſſes proceed from it, which divide the brain into certain parts.

XCIX.

Thus, when the cranium is circularly cut, there is found a very conſiderable adheſion of the dura mater to it; and, when it is drawn aſunder, we obſerve a great number of red points which are the extremities of lacerated veſſels. Hence we conceive that the dura mater ſerves as the external perioſtæum to the inner table of the ſkull; and the uſe we aſſign to it is, that of ſupplying the bone with veſſels. Hence, in performing opera-

tions, as in the trepan, we ſhould be extremely cautious not to detach more of it than is abſolutely neceſſary; and for the ſame conſideration that we avoid to ſcrape the perioſtæum from a bone, viz. leaſt we ſhould bring on a caries. It is farther obſervable, that there can be no ſuch motion of the dura mater as was formerly alleged; and, upon attending to the communication which the veſſels upon the oppoſite ſide of the ſkull have with each other, it appears probable that the affection of the external membrane may diſorder the dura mater, but not, however, in ſuch a degree as has been ſuppoſed. Where the pericranium is ſeparated with violence, the dura mater will be detached too, but this is not from the communication of the veſſels, but from the ſame violence affecting both; but, in ſuch caſes, we frequently find the dura mater adhering. As the thickneſs of the dura mater is more conſiderable than the external perioſtæum, it may ſerve alſo, as obſerved, like a ſoft cuſhion to defend the very tender ſubſtance of the brain.

C.

The proceſſes of the dura mater are three in number; the ſuperior longitudinal proceſs, or falx; the lateral one, or tranſverſe ſeptum; and the minor falx, or ſyplum of the cerebellum.

CI.

The 1*ſt* is that doubling of the membrane which ſeparates the brain into two hemiſpheres, commencing at the middle of the ſphenoid and ethmoid bones, and pervading the upper and middle part of the head, along which courſe it poſſeſſes adheſions to the different bones, being ſtraight in its direction, and in ſhape reſembling a falx or ſickle, expanding at the ſame time gradually in its progreſs from the cranium to near the corpus calloſum, and terminating behind in the middle of the tentorium. It is this proceſs that ſupports the tentorium, and thus prevents the preſſure of the two ſides of the brain on each other.

CII.

The 2*d*, or tranſverſe ſeptum, runs from the former to the os petroſum, and is connected behind to the inner tranſverſe ridges and grooves of the occipital bone, terminating at the poſterior part of the ſphenoid bone. This proceſs forms a arch or vault over the cerebellum, and prevents the preſſure of the cerebellum upon it.

CIII.

The 3*d*, or central ſeptum, is placed between the lobes of the cerebellum. It deſcends from the under and back part of the falx, and adheres to the inferior longitudinal ſpine of the occipital bone, and terminates at the edge of the foramen magnum.

CIV.

Beſides theſe, ſmall proceſſes of the dura mater paſs out at the different openings of the cranium, which are of leſs importance, but which all ſerve to connect it with the adjacent parts.

CV.

From this ſituation of the ſepta, and there going down a conſiderable way betwixt the hemiſpheres of the brain, and from obſerving the appearance of the dura mater, there is ſome foundation for ſaying that this is a double membrane, the two layers of which adhere very cloſely, and the middle parts are ſofter, and connected by ſtrong cellular threads. In the ſame manner, when the brain is raiſed from the cerebellum, there appears a ſimilar membrane ſtretched between them, all which evidently prevent one part of the brain from gravitating upon the other in the different poſtures of the body, while theſe two membranes, viz. the falx and tentorium, mutually ſupport each other; and, in ſome very large and ſwift animals, we find the partition formed of bone. Not ſatiſfied with covering the brain, we find that the dura mater runs down into the ſpine, ſerving the ſame office to the ſpinal marrow as to the brain in general; and, laſtly, we obſerve where the nerves go out to the external parts, that membrane is wrapt cloſe about them.

CVI.

The circulation of the dura mater is chiefly from the external carotid, the internal one, and the vertebrals, as we ſhall afterwards find; but what is only to be noticed here is, the particular termination of its veins in ſinuſes, for the tranſmiſſion of the blood from the head to the neck. Theſe ſinuſes are formed by a tenſe doubling of the membrane over them, ſo as to be little affected by the preſſure of the adjacent parts.

CVII.

Theſe ſinuſes are chiefly diſtinguiſhed by the ſtrength of their coats, and their frequent communications; and their ſituations are,

1. The ſuperior longitudinal one, which beginning at the criſta galli of the ethmoid bone, directs its courſe along the upper edge of the falx, enlarging in its progreſs, and terminating in the lateral ſinuſes.

2. The torcular of Hierophilus, which runs between the falx and tentorium, and terminates with the former ſinus in the beginnings of the lateral ones.

3. The two lateral ſinuſes formed by the longitudinal and torcular ones, which obſerve a varied courſe, firſt running tranſverſely, then in a winding direction downwards, obſerving the depreſſions of the occipital and temporal bones, till they

terminate at the baſe of the cranium, in the beginning of the internal jugular veins.

CVIII.

Thus the ſinuſes are the trunks of veins covered by the dura mater, and ſmall branches enter at the ſides of it. We ſhall afterwards find ſeveral uſeful purpoſes ſerved by this ſtructure, that the veins are greatly ſtrengthened by it, and ſeveral dangers thereby avoided; and, as the ſmall branches paſs obliquely through the dura mater, this oblique paſſage ſerves the office of valves.

CIX.

On the ſides of the ſinuſes, and elſewhere on the dura mater, ſmall granulations are apparent, of a whitiſh, and alſo of a fleſhy colour, the uſe of which is unknown.

CX.

Arachnoid Coat.

The ſecond covering of the brain is the arachnoid coat, ſo named from its reſemblance to a ſpider's web. It forms a very thin tranſparent membrane without any appearance of veſſels. Its expanſions ſeem confined entirely to the ſurface of the brain, and it inſinuates itſelf no way into its ſubſtance or convolutions.

CXI.

The adheſion of this membrane is greateſt at its upper part, where the connection by cellular ſubſtance is ſo ſtrong, as hardly to bear ſepara-

tion; but in other parts it appears to lie merely in contact, and is easily raised from the other parts.

The use of this membrane is like the former, to cover and defend the parts over which it is spread.

CXII.

Pia Mater.

The third covering of the brain, the pia mater, somewhat resembles the former in its tenderness, but possesses vascularity. It differs however from it, besides being a covering, in its insinuating itself deep into every part of the substance of the organ, and it forms the lining of the ventricles. It is in this membrane the vessels of the brain are contained, and by it they are supported and allowed to separate into the minute divisions which are necessary for its circulation and functions.

CXIII.

The circulation of this membrane we shall afterwards trace. It is only remarkable in so far that its veins do not accompany its arteries.

CXIV.

Brain, or Cerebrum.

The brain is divisible into four different parts, the chief of which are the cerebrum and cerebellum. The cerebrum completely fills the upper part of the cranium, and is divided into two halves, termed its hemispheres, that are preserved separate by means of the falx.

CXV.

Each of the hemifpheres difplays an oval form; the inner fides of which are flat, and the upper and outer convex, while the inferior furface is irregular. Hence it is divided into two anterior, two lateral, and two pofterior lobes or proceffes.

CXVI.

The fituation of the firft of thefe is in the fore part of the cranium; that of the fecond in the depreffions or pits formed by the temporal and fphenoid bones; and that of the third over the cerebellum, from which they are feparated by the tentorium. Between the firft and fecond there is a confpicuous furrow formed by the anterior clenoid proceffes of the fphenoid bone, termed the large pit, or foffa of Sylvius.

CXVII.

In examining the furface of the brain, it is divided into numerous windings or turnings, termed convolutions. Thefe run in various directions. They are alfo of different fizes and lengths in the feveral parts of the brain. A connection between them and the pia mater is every where confpicuous by the intervention of fmall veffels entering the fubftance of the brain; and, to detect this, it is neceffary to make a flight feparation of the convolutions from each other.

CXVIII.

The evident purpofes of thefe convolutions is to increafe the external furface, in order to give room for the very minute divifions of the blood veffels; for the pia mater, or vafcular membrane, defcends between each of the convolutions, and the feveral doublings of the pia mater are kept together by the very fine coat without veffels. The arachnoid is connected to the pia mater by cellular fubftance, and we may confider it likewife as defending the very tender veffels of the pia mater. Perhaps, farther, the arachnoid coat may prevent the concretions better than a membrane, with a great number of different veffels, and we find that nature guards againft the contact of the dura mater with the furface of the brain, by the interpofition of a liquor. If that liquor fhould at any time be collected in an unufual quantity, fo as to form a Hydrocephalus internus, the water would fall down into the fpinal marrow, between the two membranes, in confequence of which the vertebræ may be pufhed outwards, fo as to give the appearance of the fpina bifida.

CXIX.

Between the hemifpheres is obfervable a white medullary fubftance, fomewhat firmer than the texture of the brain, named the corpus callofum. It croffes the brain immediately under the falx,

and running horizontally, joins the the two hemispheres to each other. Its middle is marked by a longitudinal raphe, and on each side of it a medullary chord, giving origin to many transverse streaks.

CXX.

On cutting into the brain, immediately on a line with this corpus callosum, the substance of the organ discovers a division into two parts, an outer or cortical one, and an inner or medullary one. The first receives various appellations, being named cortical, from its manner of surrounding the medullary part, or being, as it were, the bark of it. It is termed cineritious, from its grey or ash colour; and it is styled also glandular, or secretory, from its supposed functions. The extent of this part is general over the brain, it passes deep between its convolutions, and is a congeries of vessels conveying its circulation without the appearance of any particular fibrous texture.

CXXI.

The medullary, or white part, is regarded as the origin of the nerves, and has been termed, from its supposed structure, the excretory duct of the brain. It differs from the other part, by exceeding it both in quantity and firmness of texture; but so intimately are they connected, that it at the same time appears but its continuation. Its fibres run in a parallel or transverse

direction, and the medullary and cortical parts are found in different places blended with each other. On these two different substances of the brain we observe that the cortical or cineritious substance is by no means so thick as we are apt to conceive it; the deception is owing to the convolutions of the brain, the thickness being only about $\frac{1}{6}$ part of an inch.

CXXII.

The cortical substance has every where the pia mater immediately applied to it, then the medullary substance is every where connected with the cortical, so that we cannot shew medullary fibres without being able to trace these back to a cortical substance, or a cortical substance which does not form medullary.

CXXIII.

Thus there prevails a strong connection between the pia mater and the cortical substance of the brain, the vessels of which it is evidently intended to conduct: for, if a section of the brain is examined, the vessels of the pia mater appear lodged perpendicularly into the cortical substance. Not that it can be proved entirely made of vessels, for a considerable part of it still retains its former appearances. Connected to this appears also the medullary part, which is of a fibrous nature, and the direction of the bundles of fibres can be traced, and that the nerves are its continuation.

But, where they leave the ſubſtance of the brain, without exception they are covered by the continuation of the pia mater, or a vaſcular membrane reſembling that. And, if they are intended for the external parts, and to run along the muſcular organs, there is another ſheath from the dura mater, or one ſo like it, that it may be held the ſame.

CXXIV.

The fibres of the medullary ſubſtance can be ſeen with the naked eye, and it can farther be ſeen that the nerves are every where their continuation; but, at the ſame time, all the medullary fibres are not continued to form nerves; ſome of them are continued in a direction that is the moſt unfavourable to the formation of nerves, and the fibres that compoſe the ſubſtance of the brain and cerebellum is much greater than that of all the nerves joined together.

CXXV.

On removing the cortical part of the brain, a nucleus is formed by the medullary ſubſtance alone, termed the centrum ovale of Vicſſceuns; and, to obtain a proper inſpection of it, the nucleus ſhould be cut ſo as to preſerve the corpus calloſum; and the ſame convexity is conſpicuous as in the general ſurface of the brain. By this centrum ovale is formed the roof or vault over the lateral ventricles, and its ſmooth uniform under ſurface conſtitutes their upper part.

CXXVI.

The ventricles of the brain are four in number, lined with a fine ſmooth membrane continued from the pia mater, but with leſs vaſcularity than that membrane. Theſe ventricles are compoſed of medullary matter, with their ſides contiguous to each other, and having their cavity conſtantly moiſtened by a ſerous excretion.

CXXVII.

The lateral, or ſuperior ventricles, run horizontally with the hemiſphere in which they are ſituated, one to each. They lie under the centrum ovale, of an irregular form, with each three winding corners, termed cornua, from their reſemblance to rams' horns.

CXXVIII.

The ſeptum lucidum forms a ſeparation between the anterior cornua. The poſterior cornua, though ſituated at a diſtance from each other, and termed alſo digital cavities, at their pointed extremities approach nearer to each other. The inferior cornua obſerve a courſe downwards and forwards, ſo as to end in the lateral lobes of the brain.

CXXIX.

Each of the poſterior cornua is diſtinguiſhed by an elongation ending in a point, termed the hippocampus minor. In the bottom of the lateral ventricles two eminences are placed anteriorly, named

corpora ſtriata, which gradually turn narrow, and recede from each other as they advance poſteriorly to their termination. Theſe eminences diſcover externally a cortical ſtructure, but within are mixed with medullary ſtreaks, ſome of which form large tranſverſe circles, and others obſerve a ſtraight direction.

CXXX.

Between the corpora ſtriata, at their poſterior part, are ſituated the thalami nervorum opticorum, cortical without, and medullary and ſtriated within. Upon the extremities of their ſurface are placed tubercles, or eminences. The thalami, internally, are flat and contiguous, and above their ſurface forms one cloſe attachment, named the commiſſura mollis of the opti thalami. In their courſe poſteriorly, the thalami paſs downwards and upwards; in which direction they become elongated into two white chords, named tractus optici.

CXXXI.

The thalami are covered by the choroid plexus, or a vaſcular membranous congeries, formed by the ramifications of arteries and veins connected by the pia mater, and ſpread upon the ſurface of the thalami and adjacent parts.

CXXXII.

Returning to the corpus calloſum, under its raphe appears the ſeptum lucidum, forming a partition between the lateral ventricles. The form

of this ſeptum is broad before, narrow behind, and curved at its edge; and its connections are above to the corpus calloſum, and below to the fornix.

CXXXIII.

The compoſition of this part is of cortical and medullary laminæ. At their fore part they are ſeparated from each other by the fiſſure or ſinus of the ſeptum lucidum. This ſinus, however, poſſeſſes no communication with the lateral ventricles, though at times it moves conſiderably backwards.

CXXXIV.

Under the ſeptum lucidum appears the fornix, or continuation of the corpus calloſum; ſo termed, by the antients, from its reſemblance to a vault. From the hollow cavity which it forms, proceed four winding pillars, or cornua, two anterior, and two poſterior. The two former are ſhort, and cloſely connected in their courſe; the two laſt are long, more diſtant from each other, and correſpond from their curvatures with the inferior cornua of the lateral ventricles. The thin borders of their under parts, ſituated within the latter, are termed corpora fimbriata.

CXXXV.

In its figure, the fornix is broad before and behind, where connected with the corpus calloſum. The poſterior part of its body below is impreſſed

with oblique lines reſembling a lyre, and therefore named pſalterium. The connections of the body of the fornix are above to the ſeptum lucidum, below to the thalami optici, by means of a vaſcular membrane, named tela choroidea, which, ſpreading over the thalami, unites the choroid plexus of the lateral ventricles.

CXXXVI.

In the inferior prolongations of the latter are two medullary eminences, which take their origin from the ſides of the corpus calloſum, at its poſterior extremity. Theſe eminences are termed pedes hippocampi. They obſerve the ſame courſe as the pelloris, and have been ſuppoſed as forming part of them. They ariſe by a ſmall origin, and gradually enlarge as they advance to their extremity. A medullary lamina forms their external covering, and their internal ſtructure ſhews a convoluted appearance, compoſed both of cortical and medullary laminæ. The inner edge of the pedes hippocampi diſplays an indented margin, proportionally larger in quadrupeds, and leſs in man.

CXXXVII.

The openings of the ventricles are the next important part. The firſt is an oval hole, by which the lateral ventricles communicate freely with each other. It is placed at their bottom, behind the crura of the fornix, and the meeting of the choroid plexus.

CXXXVIII.

The ſecond lobe is the iter ad infundibulum, or ventriculum tertius, ſeen on dividing and turning back the fornix. The third lobe is the foramen commune poſterius, between the commiſſura mollis of the optic thalami and the pineal gland.

CXXXIX.

The third ventricle ſtill remains, and it is only a deep fiſſure between the inner ends of the thalami optici, being bounded above by the commiſſura mollis, below by the crura cerebri, and on each ſide by the bodies of the thalami.

CXL.

A paſſage of conſiderable ſize, of a cortical and medullary ſtructure, termed the infundibulum, comes next into review. It leads downwards and forwards, and gradually contracts till it becomes ſolid at its termination. This is in the glandula pituitaria, and thus it prevents the tranſition of any fluid from it to the noſe.

CXLI.

The glandula pituitaria is of an oval form, about the ſize of a bean, of a browniſh colour, formed of cortical ſubſtance, and mixed within with medullary matter. This gland is lodged in the ſella turcica, ſurrounded by a doubling of the dura mater; and the uſe of it is completely unknown.

CXLII.

The next parts to be noticed are two medullary cords.

The firſt is termed commiſſura cerebri anterior, and is ſituated at the fore part of the third ventricle, running tranſverſely through the corpora ſtriata.

The ſecond, ſhorter than the former, is the commiſſura cerebri poſterior, ſituated at the back part of the third ventricle, under the root of the pineal gland.

CXLIII.

The fourth ventricle has a paſſage leading to it, under the name of canalis medius, from the back part of the third one; and next, in removing the poſterior part of the fornix, and tela choroidea at this back part of the third ventricle, a number of peculiar diviſions of the brain that ſtill remain, come into view.

CXLIV.

The firſt of theſe is the nates placed uppermoſt. The ſecond are the teſtes immediately below the former, of a white colour, broader from ſide to ſide than in any other direction. Theſe tubercula are externally medullary, and within cortical. Their names are more proper in quadrupeds than in man, from their greater proportional difference of ſize.

CXLV.

Under the back part of the fornix, over the nates, is placed the pineal gland. It is a ſmall cortical body, like a fir cone in ſhape, and in ſize like a garden pea, always preſent, and ſeldom found diſeaſed; hence conſidered as the ſeat of the ſoul. This gland, at the root, is fixed to the poſterior commiſſura cerebri, and ſends out two long medullary peduncles, to be fixed to the upper ſide of the thalami, and anterior crura of the fornix. In the ſubſtance of the pineal gland, ſmall calcarious concretions are obſervable after the age of puberty, termed acervulus cerebri.

CXLVI.

Thus within the brain are found many tubercles, and there ſeems to be a neceſſity ſome how or other, for reaſons that perhaps we cannot conjecture, that the ſeveral tubercles be kept from adhering to each other; hence we find ventricles within the brain, and it is of uſe to obſerve theſe hollows for the ſake of diſeaſe. We have ſeen their place and manner of communication; the two lateral ventricles communicate with each other under the anterior crura of the fornix; between theſe and the choroid plexus the communication is large enough to receive a large ſized quill. At the ſame time they communicate with the third ventricle, the hole being open underneath; and the third, by the iter ad quartum

ventriculum, communicates with the fourth, ſo that it is pretty certain that the glandula pitiutaria is of the ſame nature with the lymphatic glands in the reſt of the body.

CXLVII.

From the cerebrum we proceed to its appendage the cerebellum. It is ſituated under its poſterior lobes, ſeparated from it by the tentorium, and occupying the inferior foſſæ of the occipital bone.

CXLVIII.

Its ſize equals only about $\frac{1}{5}$ or $\frac{1}{6}$ of the brain. It is more ſimple in its ſtructure, and ſomewhat roundiſh in its form. Like the brain, alſo, it is divided by the falx minor into two hemiſpheres, but poſſeſſes no ſeparation above. Like the brain, alſo, it is marked by numerous convolutions in the form of arches decuſſating each other; and theſe obſerve a lateral direction, conſiſting of laminæ with deep furrows; between each the pia mater is inſinuated in the ſame manner as in the brain.

CXLIX.

Two middle eminences are marked out in the cerebellum, named apendices vermiformes from their reſemblance to an earthworm, one of which is placed anteriorly, the other behind.

CL.

The lobes of the cerebellum are alſo divided into ſmaller parts, lobules or monticuli, and vari-

ous names are aſſigned to theſe, according to their particular ſituation and connections. They admit ſome variety, and are chiefly diſtinguiſhed by the direction of their convolutions.

CLI.

In ſubſtance, the cerebrum and cerebellum are the ſame, only the cerebrum poſſeſſes a greater proportion of the cortical part; and, from the peculiar diſtribution of the medullary laminæ when the cerebellum is cut vertically, it diſplays the appearance of a branching ſhrub, termed therefore arbor vitæ.

CLII.

This medullary ſubſtance, when cut into, is laminated; and, at a conſiderable depth, there appears a centrum medullare uniting the lateral lobes as in the brain.

CLIII.

The next part that falls here to be deſcribed, is the fourth ventricle; the ſituation of which is between the cerebellum tuber annulare and upper part of the medulla oblongata, and it extends from the teſtes to the inferior notch of the cerebellum. As it deſcends from the teſtes it becomes wider, forming an angle behind, from which it contracts till it terminates in a point, termed the calamus ſcriptorius. Over the upper part of this ventricle is placed a thin medullary lamina, termed the valve; and at the ſide of this

valve, are two medullary tracts, termed processus ad testes. The under part of the ventricle is shut by its choroid plexus, so that no communication can take place between it and the spine.

CLIV.

Under Surface of the Brain.

Between the lateral lobes of the brain, at its base, are placed two small round white bodies, named copora albicantia, being without of a medullary, and within of a cortical substance. In these bodies are the terminations of various medullary striata from different parts.

CLV.

Immediately before these bodies appear two white cords named the pedunculi cerebri, which originating from the medullary substance of the brain, gradually approximate in their course, till they unite in the tuber annulare. They are composed of medullary fibres, and possess, internally, a mixture of cortical and medullary matter; the former of which is so conspicuous at one particular part, as to give it a darker colour, and occasions it to be named locus niger crurum cerebri.

CLVI.

A cortical substance, termed pons tarini, forms a junction of the opposite sides of the crura cerebri, and corpora albicantia together; and it further assists to compose the bottom of the third

ventricle. Two white cords alſo ariſe from the medullary part of the cerebellum, entitled the crura cerebelli; and with the crura cerebelli, they compoſe the tuber annulare, or pons Varolii, which forms a ring or bridge at it were over theſe crura. Thus the tuber is ſituated over the body of the ſphenoid and cuneiform proceſſes of the occipital bones. It is ſtretched along its ſurface, and divided by a longitudinal depreſſion from the courſe of the vertebral artery into two lateral parts. It contains in its ſubſtance much cortical matter, the ſtriæ of which obſerve various directions. Extending from the tuber, appears the medulla oblongata, a large ſubſtance in the form of an inverted cone, and reaching to the foramen magnum of the occipital bone. On its ſurface appear two ſmall longitudinal contiguous eminences, named, from their ſhape, corpora pyramidalia, between which there is a deep fiſſure, penetrated by the pia mater, for the paſſage of blood veſſels into the interior medulla. At the outſide of theſe eminences are alſo two others, named, from their appearance, corpora olivaria; and ſtill more externally are a third and leſs diſtinct pair, termed corpora pyramidalia lateralia.

CLVII.

The medulla oblongatu, thus ſituated, is formed of medullary matter externally, and cortical within, joined by medullary; and it is divided by means

of an anterior and poſterior fiſſure into two lateral portions.

CLVIII.

Thus we have examined the brain in its ſeveral parts, or that organ which is the ſource of nervous influence, the primary organ of ſenſe with which the mind is ſuppoſed to be immediately and moſt intimately connected; we ſhall next purſue the detail of its circulation, which is alſo peculiar and important. We formerly traced the external carotid to the angle of the lower jaw. There it divides into two great branches; the firſt, preſerving the name of external, is diſtributed on the outſide of the head; while the ſecond, the internal branch, paſſes, in order to give circulation to the brain; and, in doing this, it is aſſiſted by two others, the vertebral arteries, which ariſe from a different ſource, or the axillary. By theſe arteries paſſing on each ſide into the head, an immenſe ſupply of blood is conveyed to the organ, and not leſs, on the moſt moderate calculation, than $\frac{1}{10}$ of the whole maſs; and, as the arteries are large, and their action powerful, the violence of their circulation from being injurious to the ſoft texture of the brain, is purpoſely counteracted by a number of circumſtances.

CLIX.

The *1ſt* of theſe circumſtances is the tortuous courſe of the arteries, as they paſs into the head.

The 2*d* is the entrance of the carotid to the head through a long bony canal, giving reſiſtance to its impulſe.

The 3*d* is the minute diviſion of the arteries, and their diſperſing on the pia mater before they paſs into the ſubſtance of the brain; and

The 4*th* is the thinneſs of the arterial coats in the brain from what they are elſewhere.

CLX.

With theſe peculiarities in the circulation of the head, the carotid, on entering it by the os petroſum, gives off three branches at the ſide of the ſella turcica, which it firſt reaches.

CLXI.

Arteria Media Cerebri.

The 1*ſt* is the middle artery of the brain, which is to be conſidered as the arterial trunk. It runs ſtraight along the foſſa ſylvii, formerly deſcribed, and goes directly outwards towards the temple. In the foſſa ſylvii it divides into two branches, a deep and ſuperficial one, but its main circulation is ſpent on the middle lobe of the brain. Previous to its lodgement in the foſſa ſylvii, it gives off ſome ſmall delicate twigs, which are diſtributed to the pituitary gland, the optic nerve, the tentorium, and pia mater, at the cranial baſe. The chief of theſe twigs are the artery of the choroid plexus running up into the anterior horn of the lateral ventricles and the plexus of arteries, like ſewing

threads ſcattered over the crura cerebri and baſe of the brain, and marked by their numerous inoſculations.

CLXII.

Arteria Anterior Cerebri.

The next diviſion of the carotid is named the fore artery of the brain, which obſerves a ſtraight courſe along the anterior lobe. It gives off branches to the olefactory and optic nerves. The branches then, of this artery, on each ſide meet, and form a communication juſt before the ſella turcica and pituitary gland. From this part it diſpatches a branch to the third ventricle, which gives off ſubdiviſions to the fore part of the fornix and ſeptum lucidum. Its two diviſions then riſe, and keep the courſe of that ſeparation which the falx makes between the hemiſpheres, the one obſerving a deep, the other a ſuperficial route.

CLXIII.

Arteria Communicans.

While the former artery goes to the fore, this one paſſes to the back part of the brain. It goes round the ſides of the corpora mammillaria, and it ſoon meets the vertebral artery, and thus it forms, though itſelf a ſmall artery, one of the largeſt and moſt important inoſculations in the body. This inoſculation is termed the circle of Willis; and the vertebral artery, thus connected, gives off three diviſions; two to the cerebellum, and one to the back part of the brain.

CLXIV.

Vertebral Artery.

This artery arifing from the axillary one, conveys much blood to the brain, and it obferves the fame courfe and precautions with the carotid before its entrance to the organ. On entering the foramen magnum, it foon meets its fellow, and the two unite into the bafilar artery, which lies upon the cuneiform procefs of the os occipitis and the tuber annulare of the brain, which it marks with a furrow or depreffion, and in its progrefs it gives off fmall twigs to the adjacent parts. On the vertebral paffing into the bafilar artery, it fends off the lower artery of the cerebellum. It differs in its fize on each fide, and is fometimes wanting. It moves down in a retrograde courfe, and dives in between the cerebellum and medulla oblongata. When the vertebral artery arrives at the pons Varolii or tuber annulare, it fends off at once four arteries, two to each fide of the brain. The firft, or thofe to the right fide, named arteria cerebelli, bend round the crura cerebri to get at the cerebellum, to which it gives branches afide to the vermis. The fecond, or thofe that pafs to the left fide, named arteria pofterior cerebri, obferve the fame bending courfe with the former, and go into the divifion between the cerebrum and cerebellum, running up to the back lobes of the brain. They fend off alfo numerous twigs in

every part of their courſe, and they inoſculate with the middle artery of the brain, and that of the corpus calloſum.

CLXV.

Thus by the internal carotid and vertebral arteries is the whole brain amply ſupplied with blood; of the membranes, the veſſels of the pia mater are derived from the ſame ſource; but the dura mater, on the contrary, receives only a part from this quarter, and its chief circulation is from the external carotid.

CLXVI.

Having thus ſeen the diſtribution of the internal carotid, or chief cerebral artery, and obſerved alſo that it freely communicates with the vertebral one, there appears little danger of the ſtoppage of the blood in any part of the organ, and numerous examples occur of anaſtomoſes between the internal and external arteries; hence, after tying the carotis communis, not only the functions of the brain continue, but alſo thoſe of the external parts, the blood getting through the vertebral to the internal carotids, and from theſe into the external ones. From theſe communications it has been propoſed, where the head ſeems to be oppreſſed with too great a quantity of blood, which is frequently a cauſe of apoplexy, perhaps alſo of epilepſy, to leſſen the quantity by tying one of the carotids. Now, although, from

the vicinity of the nerves of the eighth pair and intercoſtals, this experiment is attended with a conſiderable degree of danger, independent of that from tying the artery; yet, ſurely, the idea is worth purſuing in other animals; ſo in the ſtaggers, or epilepſy in a horſe, we might tie one of the carotids to ſee the effect.

CLXVII.

Next, attending to the ſituation of the carotids with reſpect to each other, the internal is ſent off at an angle, and the external is the more direct continuation of the trunk; and the vertebral arteries ariſe at a right angle, and form the ſub-clavian. We find that both the arteries which ſupply the brain come off in an unfavourable manner.

CLXVIII.

When we proſecute the particular branches of the external carotid, the firſt branch is ſent to the larynx, and then turning downwards, it enters the thyroid gland, where it freely communicates with an aſcending artery; and, examining the ſtructure of the gland, we find that a great quantity of blood is circulating here. It is of uſe to attend to the ſize in certain operations, particularly in bronchotomy, where we muſt generally cut through this gland; and, if this is done, the blood getting into the trachea, may raiſe a convulſive cough, which is attended with

real danger. Now, confidering that operation, we may reflect on the ways of gaining advantage in certain cafes of inflammation, and of avoiding the danger of blood falling into the lungs.

CLXIX.

Higher than this, a confiderable branch of the lingual paffes above the corner of the os hyoides, which, joined to its fellow, conveys a very large portion of blood. It is of ufe to judge of its fituation in chirurgical operations, where tumours prefs in here, and we do not readily know its courfe by the finger, becaufe it is fupported chiefly by flefh, fo that we fcarcely diftinguifh its pulfation.

CLXX.

The next artery we call facial, fupplying the inferior maxillary, and fublingual gland. The branches are fet off at right angles, as thofe of the temporal artery, that fupplies the temporal glands. So thefe are not more particularly fitted to receive the very active mercury than the others; and the effect of the artery in throwing out the mercury, is not to be afcribed to its paffing off at a right angle, but to the ftructure of the ultimate branches, or of the gland, and the greater fenfibility of the part.

CLXXI.

Going ftill higher, we find the facial artery paffing over the lower jaw, about an inch from its angle, fo called arteria angularis; and here we

can diſtinguiſh the pulſation, and can open it on certain occaſions. In ſome operations we allow the parts to bleed freely; and it may be of advantage to empty all the veſſels very fully; but in many other caſes we wiſh to ſtop the bleeding, as in the operation for the hare lip, in the caſe of wounds, &c. And ſurgeons generally uſe preſſure upon the extremity of the bleeding artery, or take it up with the needle. But applying two fingers upon the root of the facial artery, will aſſiſt very conſiderably; not but that the blood will be poured in in ſmall quantity from the neighbouring branches; but if the principal ſource is interrupted, that will be found to ceaſe.

CLXXII.

Purſuing the facial artery higher on the face, we find it ſupplying the ſmall glands of the lips; and the ſerpentine turn it takes ſerves a double purpoſe, allowing an extenſion of the mouth, the artery coming nearer to the ſtraight line; but the turns are greater than what is neceſſary for that purpoſe; and conſidering the ſituation of the veſſels within the muſcles, we may conceive that, from the ſituation and courſe, the ſaliva is better prepared, and the ſecretion increaſed by the motion as well as the exertion. At the top of the face we find the artery communicating with the ocular and frontal ones, or communications between the internal and external arte-

ries. Hence the room for Dr. Blain's propoſal to open the frontal artery in the diſeaſes of the head; but this operation is to be avoided particularly, from the artery being turned over a bone, ſo that it is impoſſible to relax it.

CLXXIII.

Following the artery ſtill higher, we find the occipital one ſent backwards. From the root of the temporal artery, the trunk of the carotids is turned inwards, and then it gets the name of the internal maxillary, ſplitting into a number of very great branches, ſupplying the muſcles, the ſubſtance of the jaws, the roof of the mouth; and there is a branch going into the dura mater, and to the artery terminating in the ſides of the noſe, which is a continuation of the external carotid. Though theſe ſeveral branches never fall in the way of a ſurgeon, yet it is of uſe to know from what ſource each organ receives its blood; and the knowledge of their connections and vicinity may be of advantage in certain dangerous diſeaſes, to leſſen this force very conſiderably. Thus, if the dura mater is inflamed to a great degree, or in the caſe of teething in children, the force of the blood may be more leſſened by opening the temporal artery in the neighbourhood, than by opening veſſels that are more diſtant.

CLXXIV.

Correſponding to the arteries, there are two

fets of veins, viz. the internal jugular attending the carotis communis, and two external jugulars. So that even in this part of the body, where the blood returns the moſt readily to the heart in the erect poſture, there are under our muſcular organs veins running in very different directions, and one ſet on the outſide of the muſcles, free from the action of the muſcles, and frequently communicating.

CLXXV.

In the external jugular veins there are alſo valves which are in proof that they are chiefly intended to prevent the blood from being driven backwards to the ſmall branches.

CLXXVI.

From the free communication which the external jugulars have with the internal, it is clear that the drawing blood from them in diſeaſes of the head, may be attended with particular benefit; and the only danger attending the opening of them, ariſes from certain ſmall nerves, branches of the cervicales.

CLXXVII.

Having now traced the ſtructure of the brain, and its circulation, there are ſeveral things that merit attention in review.

CLXXVIII.

From the appearance of the internal carotid and vertebral arteries, it is clear that a greater

than the common proportion of blood is circulated here; thus, comparing the brain and cerebellum with the arm upon which we find only the axillary artery ſpent, each of the internal carotids are nearly as large, and the two vertebrals joined together are larger; or there is about three times the quantity circulated within the head that paſſes through the arm. The quantity, however, is not ſo great as ſome ſuppoſe. If the quantity is to be judged of, nearly one-tenth, or one-twelfth of the whole is circulated upon the ſurface of the brain and cerebellum; but we are obliged to make a deduction from this proportion, becauſe the force of the blood within the head is broken from a number of circumſtances: the momentum is in a ſingular manner diminiſhed. An allowance muſt be made for the blood riſing contrary to its weight; and this has greater effect than is commonly imagined. In a perſon diſpoſed to dropſy, it generally appears firſt in the feet: from the deſcent of the blood the exhalation is greater, as well as the abſorption more difficult; and a change of poſture in inflammatory caſes is ſometimes attended with particular advantage. Beſides, when we attend to the coats of the arteries, they are very thin within the head, and even without the head; they are thinner in the extremities, and are thinner in the ſuperior extremities than in the lower, though both are equally

affected by the action of muscles. So the momentum is considerably diminished by the ascent of the blood, and it is lessened also from the thinness of the coats, for the living power of the arteries contributes to carry on the circulation.

CLXXIX.

In addition to these circumstances, both arteries, the carotid and vertebral, make more turns in running upwards than are necessary. We do not see the use of the turn made by the internal carotid on the outside, and still less any necessity for the several turns it makes in its passage through the os petrosum. Surely we can assign no other purpose, than that nature intends to break the force of the circulation; and in other animals, where the head is depending, and the force greater upon the arteries, they are in a singular manner divided into minute branches, which are collected from a trunk a second time, whereby the force of the blood must be greatly broken, as it is from its passage from the arteries into the veins.

CLXXX.

When the arteries are pursued further, we perceive that the branches bear a great proportion to the trunks; we cannot make an exact comparison with the other arteries, but we can readily perceive that they are numerous, and the surface of the pia mater is vastly increased by the doub-

lings in the convolutions of the brain and cerebellum. But notwithſtanding theſe ſeveral circumſtances that diminiſh the force of the blood, we are by no means to conceive that the arteries of the brain want pulſation, and that the blood moves in them nearly in the ſame manner as it moves through innumerable tubes. The reaſons given for this are by no means concluſive, as that the carotid artery paſſes through a hole in the cranium, and has its ſides glued to the hole. The coats have, indeed, no motion in the os petroſum, but it does not prevent the impulſe of the heart, for the pulſation remains in an artery after it is cut in the middle, and the ends of it joined by a tube; and the pulſation of the arteries of the brain has been diſtinguiſhed after the ſkull was removed. But it has been alleged that there is not the ſame motion before the ſkull is broken, and that it is owing to the air having acceſs, while before this theſe arteries could not contract, otherwiſe it would form a void. Now, if it can be ſuppoſed that all the veins that let out the blood are accurately tied up, after the artery is fully ſtretched it cannot be emptied. But if the artery and vein run parallel, and the heart gives a ſtroke, this is extended, and paſſing upon the brain, it puſhes the blood down to the heart; and now the coats contracting, puſh the blood forwards into the brain. So the blood moves in

the ſame manner in the thinner part of the head as in the reſt of the body, by the alternate dilatation and contraction of the arteries.

CLXXXI.

It is alſo to be recollected, that the obſtruction in any particular part is guarded againſt by the unuſual joining and anaſtomoſis of the principal trunks; ſo that a circulation is formed round the ſella turcica; and therefore, though from accident, or diſeaſe, or perhaps of motion of the head, &c. any one of the four principal arteries is ſtopped, the blood can paſs to every minute termination in the head; and in proof of which, the common carotis may be tied, and yet the ordinary functions performed. So, upon the whole, we find a more than common quantity of blood furniſhed to the origin of the nerves, and that this is circulated in a very curious manner; it paſſes in the uſual way into the beginning of the veins accompanying the ſmaller arteries, but theſe terminate in ſinuſes, which receive a covering from the dura mater, the uſe of which is very conſiderable, and they are ſo formed and diſpoſed, that the brain cannot very much diſturb the motion, as they only run where the dura mater is drawn out, ſupported, and made tenſe; nor can the ſinuſes ſwell out much, ſo as to diſturb the functions of the brain, from their being ſo glued to the bones. When we conſider their

ſhape accurately, we find it ſomewhat like three portions of a circle joined together. So we ſee one material uſe of the ſinuſes. But there is another, by the adding the dura mater to the veins, a greater thickneſs is given to them; and, by the veins paſſing into them in an oblique manner, the ſame effect is produced as if they had been provided with valves at their openings. Hence, when the ſinuſes are injected, it is ſeldom we ſucceed in filling the ſmall veins of the brain: for there is an oblique entrance into them like that into the biliary or urinary ducts, which ſerves the purpoſe of valves, and this is of conſequence: for the blood paſſes with greater difficulty in expiration than in inſpiration. Thus, when there is a ſtagnation of the blood on the right ſide of the heart; and if, at the ſame time, whilſt violent exertions are made by the heart, the body ſhould be bended, and the muſcles of the neck in action, the blood might have been thrown back into the thin veins: but, in conſequence of the oblique paſſage, though the blood ſhould be thrown back with conſiderable force, they receive almoſt nothing of the impulſe.

CLXXXII.

From the ſinuſes the blood paſſes into the internal jugular vein: this is a veſſel of very conſiderable ſize, and is made larger in proportion to its artery. So anatomiſts miſtake in conceiving

the ſinuſes great receptacles of blood, in which it undergoes great changes. The lateral ſinuſes are ſcarcely larger, compared with the carotid and vertebral arteries, than the veins are in other places. But their coats yield readily in the human body; and in animals that dive under water, we find large bags to prevent the accumulation of the blood within the head.

CLXXXIII.

There are two motions in the brain. 1*ſt*, The common pulſation, produced by the ſtrokes of the heart. 2*d*, In the unequal ſtates of reſpiration there is a conſiderable preſſure backwards; for the internal jugular has but a pair of valves, which do not accurately prevent the regurgitation of the blood, and the diſcharge of the ſmaller veins into the ſinuſes is for ſome time ſtopped, and hence takes place a conſiderable ſwelling of the larger branches of the veins entering into them. If a conſiderable portion of the ſkull is removed, and the membranes detached, that alternate dilatation is ſeen in a very remarkable degree; and we are apt to be deceived in ſuppoſing that ſuch a motion takes place before the brain is opened; but there is no ſuch heaving of it in ordinary, as occurs in this experiment; for, ſuppoſe a ſingle half ounce is thrown into the brain, the whole impulſe appears at the ſpot. However, though we allow that the brain has a pulſation of

its arteries as in other places, and that there is no great difference in the return of the venous blood, we have it not in our power to empty the veſſels of the brain by letting blood, as we can empty the veſſels of other parts. Thus, if a pound of blood is drawn from the arm, the veſſels are emptied, the bulk of many parts of the arm are leſſened, and the veins ſubſide and become ſmaller. But this cannot happen in the brain, which conſtantly contains nearly the ſame quantity, abſolutely the ſame, if we conſider the large and ſmall veſſels: thus, if the large veſſels receive a violent impulſe, they make a ſtrong preſſure againſt the ſmaller, and ſqueeze out their liquors towards the heart, and the quantity contained in the brain will be at all times equal, nor can we leſſen its bulk without making a void.

CLXXXIV.

From the danger ariſing from a ſtoppage of the blood within the head, it has been imagined that when perſons have been killed by hanging, it muſt be owing to the ſtagnation of the blood within the head. But the blood continues to find its way into the heart, although there may be a kind of ſtupor and oppreſſion from the preſſure upon the veſſels; for, upon opening the trachea arteria of a dog, it was kept hanging three quarters of an hour without being killed; but, upon putting the rope under the hole, it was found irrecoverably

dead after ſeven minutes; ſo that the death is chiefly owing to the ſtoppage of the reſpiration. And the only circumſtance for diſtinguiſhing whether a perſon has been hanged before death, is, that if he is killed by hanging there is a purpleiſh ring about the neck, which is not produced by hanging a dead body upon a rope.

CLXXXV.

In the ſpinal marrow the circulation is carried on in the ſame equable manner as in the head, the quantity of blood is proportionally great, there are every where anaſtomoſes of the veſſels, and the ſame means are taken to break the force of the blood in them.

CLXXXVI.

Eye.

After the demonſtration of the brain, and its circulation now proſecuted, we ſhall view its expanſion in one important organ, and the particular ſtructure of the latter, or the eye. The ſituation of this organ was formerly pointed out in the Oſteology, and the different parts of the orbits or bony cavity demonſtrated. They are lined by the continuation of the dura mater, which becomes connected with the perioſtæum of the face.

CLXXXVII.

Eye Brows.

The firſt part to be here noticed is the eye-

brows, or the arch of hairs on the fuperciliary ridges of the frontal bone. Their pofition is oblique, with their roots to the nofe, and their fituation is elevated by a quantity of cellular fubftance. They are covered by the furrounding mufcles. In their ufe, befides ornament, they form a fhade and defence to the eye, and alfo affift in expreffing the paffions.

CLXXXVIII.

Eye Lids.

The fecond part to be examined is the eye lids, which are a doubling of the fkin, inverted at the edge of the lid, and then laid over the fore part of the ball, fo that, though common teguments, from the edge of the eye lid they become a great deal thinner, but the fame general ftructure remains; and the veffels fhining through, communicate their colour. Hence we find, that where an inflammation attacks the eye, the loofe fkin within the eye lid fwells out, fometimes, almoft to cover the cornea. In the doubling of the eye lid there is a firm fubftance, the fhape of which is feen on turning out the eye lid; it is intended to prevent the eye lid from wrinkling, to ftretch it properly, and make it take the figure of the ball. This is called the ciliary cartilage, and is largeft in the upper eye lid, which chiefly poffeffes motion. Immediately within the hairs upon the eye lid, which are longer

in thofe of the upper than under lid, is perceived a vaft number of fmall openings that are juft vifible to the naked eye. They are the mouths of ducts which are fituated upon the cartilage below the inner fkin; their length is nearly equal to the breadth of the cartilage; they run in a ferpentine direction, and the matter they contain appears yellowifh when we look at the ducts lying upon the cartilage, but upon fqueezing the ducts we find it whiter. Thefe ducts ferve to prevent the injury that would arife from the meeting of our eye lids, by leffening the friction. They are very often the fubject of difeafe, where the eyes are tender; and we are obliged to fupply the want of this matter. Hence the ufe of the opthalmic ointments.

CLXXXIX.

Lacrymal Gland.

The next part that comes into review is the lacrymal gland, fituated in a hollow, at the upper and outer part of the eye, behind the outer end of the fuperciliary frontal ridge. It is an oblong yellowifh gland, with one end pointed to the nofe, and the other to the angle of the eye. A chain of fmaller glands is alfo confpicuous in the fame fituation, connected with it; the excretory ducts are numerous, but from their minutenefs difficultly traced.

CXC.

Puncta Lacrymalia.

From the gland we are led to the puncta lacrymalia, two ſmall orifices in the lids, at the inner angle of the eye, one above and another below, which hold the direction of the edge of the lids, and terminate in the lacrymal ſac.

CXCI.

Caruncula Lacrymalis.

They are kept ſeparate by the caruncula lacrymalis, a ſmall ſebaceous gland, which is ſituated beſide them, and for preſerving the functions of which it is intended. Between this part and the ball of the eye lies alſo the valvula ſemilunaris, or conjunctive creſcent, with its horns directed to the puncta, in order to aſſiſt the courſe of the tears in paſſing into them. In other animals it is large, and termed the membrana nictitans.

CXCII.

With this previous ſtructure we are brought to the ball of the eye. In attending to its general form, we obſerve that it is compoſed chiefly of coats and humours, with a nervous and vaſcular ſtructure.

CXCIII.

Ball of the Eye.

The fore part of the eye is rounder than the reſt, or the cornea is a portion of a ſmaller

circle above that, formed by the tunica ſclerotis, which makes a portion of a larger circle, and the optic nerve enters the eye towards one ſide, neareſt the inner ſide. The lens is flatter upon the fore than the back part, and the ciliary proceſſes are connected to the edge of the chryſtalline lens.

CXCIV.

It is not ſufficient that the bottom of our eye be made more ſenſible than the reſt of its body in order to perceive the impreſſions of light, but it is alſo neceſſary that the light be collected, as the rays of the ſun are collected with a burning glaſs, by which means the rays make a ſharper ſtroke upon the retina. The humours of the eye, three in number, the aqueous, chryſtalline, and vitreous, are perfectly fit for defending the ſenſible bottom, and for collecting the rays. By their pellucidity they allow them to paſs through, by their ſoftneſs they defend the parts, and by their ſhape they collect the rays, which form a picture of the object at the bottom of the eye.

CXCV.

Humours of the Eye.

Chryſtalline Lens.

Of the humours, the chryſtalline lens, the middle one is the principal, for with it, when cut of the body, a picture can be formed as with a burning glaſs; ſo that it is calculated to collect

the rays upon the bottom of the eye, and it can do this independent of assistance from the other parts, though these co-operate. In its structure, the lens is a firm substance, inclosed in a capsule, and which gradually grows softer towards the edges. This has led to the opinion, that a fluid is interposed between the capsule and the lens. But in a recent subject, there is only a solid; and the reason of the softness is, that in all substances the rays are collected in an unequal manner, the edges drawing them to a point sooner than the middle. Hence there is no perfect focus made by art; but here, in consequence of the softness, the light is less gathered at the edge, so that all the rays unite at the bottom of the eye

CXCVI.

There are vessels of considerable size that are seen upon the capsule in children, which afterwards exclude the red globules, but continue to circulate the other parts of the blood. This structure serves to prevent the tender eyes of children from being injured by the light; and there is a want of clearness in their vision. Hence the capsule is provided with vessels, so that in certain cases that membrane may be thickened by inflammation, and be a cause of opacity. Hence, also, although in the cataract, the opacity is chiefly seated in the body of the lens, it may be confined to the capsule; for, after the body of the lens has been

extracted, it ſometimes becomes opaque from the wound, and the admiſſion of the air, becoming thicker and darker.

CXCVII.

Vitreous Humour.

The vitreous humour is placed between the lens and bottom of the eye. It appears like the glare of an egg, but we have reaſon to believe that it is confined in a capſule, though that is not ſo evident. It has been conſidered as ſplitting on the fore part into two diviſions, when, in reality, it is difficult to ſhow from diſſection its exiſtence; only the ſurface remains for a conſiderable time ſmooth, and we ſee veſſels running through the middle of the vitreous humour, and we can ſcarcely ſuppoſe that they want a membrane to ſupport them. Its principal uſe is to ſupport the lens at the proper diſtance from the bottom of the eye, as on a cuſhion; and by its being thinner than the lens, it alſo aſſiſts in collecting the rays; for if it had not been interpoſed, the picture would have formed behind the retina.

CXCVIII.

Aqueous Humour.

The aqueous humour is placed between the lens and cornea, in which the iris is placed, ſo that it is partly lodged on the one ſide, and partly on the other ſide of the iris, poſſeſſing what are called the anterior and poſterior chambers;

the anterior the larger. We are uncertain whence it is derived, whether from the cornea or iris; but we fufpect that it is from the latter, as the veffels upon the iris feem better fitted for providing this humour, which is regenerated in the fpace of 24 hours; and we have feen an injection with turpentine rifing from the iris through the aqueous humour, probably imitating the natural fecretion. The aqueous humour allows the motion of the curtain, the iris, to regulate the light paffing through the eye. Befides, the chryftalline is much better removed from danger, as from blows, &c. a flight rub might have difordered the lens, its veffels, and capfule; and there is reafon to imagine that it helps to keep the cornea tranfparent, for it is naturally interpofed between the layers, and paffes through thefe; and after death the eye lofes its fhape, this humour exuding through the cornea.

CXCIX.

Coats of the Eye.

From the humours, we come to the containing parts, the feveral coats of the eye, beginning with the innermoft, the retina, which is the continuation of the optic nerve, and takes its rife from the thalami nervorum opticorum, from a certain tubercle forming the bottom of the lateral ventricles, and the fides of the third ventricle. Hence we underftand why in the internal hydrocephalus the

eye comes to be affected: there the thalami are squeezed on two sides, above by the water in the lateral ventricles, and within by that in the third, the ventricles all communicating. So the affection of the eye points out the collection within the head.

CC.

When these nerves are traced from the thalami, we find that they are united. It is conceived that this union is made by a cellular substance; but we can in this way give no rational account of the union, and there appears a real intermixture or decussation of fibres, or that the right optic nerve is formed from both the thalami nearly equally; and the advantage of this is apparent, for it is better that the half of the sensibility of both should be preserved, than that the sensibility of one should be altogether lost. Many advantages are derived from two eyes; and from their uniform motion, distances are better judged of, and accidents better guarded against; and a particular advantage arises from a mixture of the optic nerves where they adhere.

CCI.

On following the nerve into the eye, it is crooked a little between the foramen opticum and ball of the eye, to allow the free motion by the recti muscles; it then enters, though not directly, opposite to the pupil, but at the inner side. Now,

what reaſon do we aſſign for this? An experiment ſhews the uſe of it in the cleareſt manner. If the picture is brought to fall upon the entrance of the optic nerve, you loſe the object altogether. Thus, if we ſhut one eye, and look at a piece of chalk before us, and ſee it from the image falling on the outſide, turning our eye ſo far, we loſe it: this we might ſuppoſe owing to the obliquity; but following it a little further, we ſee it again: and, on making the experiment with accuracy, we find that we loſe an object whoſe diameter is equal to one-ninth of the diſtance; ſo, nine feet diſtant from the eye, you will loſe a circle one foot in diameter.

CCII.

It is material to attend to this, becauſe many have imagined the ſenſibility to be owing to the ſmall artery entering with the nerve; but we find, on making a calculation, that the whole medullary ſubſtance, or entrance of the nerve, is inſenſible, the nerve not being ſpread into parts fine enough to receive the impreſſion; as when a nerve is ſpread upon the tongue or noſe, the nerve is not fitted to receive the impreſſion. The nerve enters towards the inner ſide, and we find, from attending to the angle the eye forms with the object, that the entrance is ſomewhat more than $\frac{1}{6}$ of an inch removed from the centre of the eye: thus, ſuppoſe you paſs a needle through the eye,

and meaſure from the bottom ſomewhat more than $\frac{1}{6}$ of an inch, that is the place where the optic nerve enters. The reaſon of its entering at the inner ſide is evident; if the nerve had entered at the outer ſide, pictures of a ſingle object would have formed at the ſame inſtant in both eyes, but the rays fall upon the outer ſide of the left, when on the inner ſide of the right.

CCIII.

Retina.

We find the nerve forming the retina, which is the expanſion of the medullary ſubſtance. The name is improper, for it is an uniform membrane, and no net-work, which would have loſt parts of the objects, for it expreſſes nothing more than a web uniformly extended upon the inner ſide, covering the vitreous humour. It has been deſcribed as going to the edge of the chryſtalline lens, and ſome of the fibres paſſing over it. But it is unneceſſary that they ſhould extend over the lens; it would have diſturbed the viſion upon the poſterior part, and we find that it terminates like the edge of a tea-cup behind the lens. There may be ſome fibre, perhaps, going forwards to the chryſtalline lens; it may receive a nervous fibre from the retina, though it ſeems rather to receive it along with the veſſels.

CCIV.

Choroid Coat.

It is covered by the choroid coat, the inner fide of which is incrufted with a black point, forming the appearance of a membrane. That ferves the very oppofite purpofe of quick-filver on the back of a mirror, it prevents the reflection of the light, or its being thrown back again fo as to make a fecond impreffion, it fuffocates the rays. From the experiment, that the entrance of the optic nerve is infenfible, other anatomifts concluded that this coat was the organ on which the picture made its impreffion. But we obferve that blindnefs is occafioned by a difeafe of the thalami nervi optici, by preffure upon them, or what is the ufe of the retina, why fo fine a web, if it is only a fort of cover to the choroid? Next, purfuing the choroid as a web and firm fubftance, we find it makes a turn, and it is connected to the chryftalline lens by what has been named the ciliary proceffes, which are only the terminations of this coat contracted into a narrower circle, juft as the fleeve of a fhirt is folded into a number of doublings at the wrift. Hence there is no fpace for light paffing between the ciliary proceffes and the lens; if there was, the aqueous humour would mix with the vitreous, but it feparates thefe, and ferves to fupport the chryftalline lens in its place, which refts upon the vitreous humour as upon a cufhion,

and is ſupported at the edges by the continuation of the choroid coat. This opinion has led to very wrong ideas of the part affected in diſeaſes of the eye, all the rays of light that ſtrike the retina have before that paſſed through the chryſtalline lens. Thus, if a cataract is uncommonly opaque from the want of ſenſibility to light, we are not immediately to infer that the retina is in a diſeaſed ſtate, unleſs we find other circumſtances that may lead us to ſuſpect this.

CCV.

Iris.

We next conſider the iris, deſcribed as the continuation of the choroid coat, one part of which is ſuppoſed to form the ciliary proceſſes, and the other the iris; but other anatomiſts obſerve, that the iris is totally diſtinct from the choroid, and is merely connected to it by the ciliary circle, or they are joined by cellular ſubſtance, which alſo connects the iris to the ſclerotic coat, ſo that the watery humour is prevented by the ciliary circle from entering between the ſclerotic coat and the choroid; and thus we obſerve a white opaque ſubſtance, forming a ciliary ligament at the root of the iris. The iris has an aperture in the middle, which we call the pupil of the eye. When we follow the veſſels of the iris in an injected preparation, theſe are chiefly derived from the choroid coat, and we find nerves entering in conſiderable number. Near the root

of the iris there is a circular artery, or at its root all the veſſels communicate; we then trace them to the edge of the iris, and follow them all this courſe with the naked eye, and yet many anatomiſts imagine that no red blood enters the iris, and that its veſſels convey colourleſs humours only; but beſides this evidence, from the appearance of the veſſels, from accidents, we know that, the iris circulates a conſiderable quantity of red blood, which is ſeen mixed with the aqueous humour. In ſuch caſes, a cloud or film appears within the cornea, and upon holding the head ſteady, the cloud goes off. That proceeds from the red blood being mixed with the aqueous humour. When the head is held in one poſition, the blood falls to the bottom of the humour, and the iris is not connected where the ſclerotic coat joins the cornea, but behind the joining, ſo that it falls lower than the edge of the cornea, and goes entirely out of ſight: and, in attempting to extract the chryſtalline lens, if the iris is wounded, red blood comes from it, and there is a great redneſs and inflammation of the part. Hence it is certain that theſe veſſels convey the red blood in life, but the red colour of the veſſels is concealed from us by that paint or colour which is laid over them, and the aqueous humour is probably ſecreted from the veſſels of the iris.

CCVI.

The principal uſe of that coat is to exclude a ſuperfluous quantity of light, and to allow as much as is uſeful to reach the retina; hence, when the eye is turned towards the light, the pupil is ſmaller; and when it is turned from the light, it becomes larger, adapting itſelf to the quantity of light. But there is ſomething more than that happens; it is not merely affected by the general quantity of light, but it is contracted or widened wherever objects become indiſtinct, by being placed too near the eye; thus it contracts if the object is indiſtinct; and turning the eye downwards, the pupil gets a certain diameter; but, if the point of a ſmall pin is brought near the eye, the iris, though not now ſolicited by more light, contracts a little more than before to ſee it diſtinctly. Thus if there is a ſmall hole made in a bit of paper, and there is brought to it a ſmall printed book which appears confuſed, when viewed through the hole it appears more diſtinct, and this experiment enables us more readily to receive the fact, that we diſtinguiſh the motion of the iris in viewing near objects.

CCVII.

This circumſtance reſpecting the pupil is of the utmoſt conſequence to attend to in judging of diſeaſes. When the eye is inſenſible to the light, there is a very ſmall degree of motion in the iris;

and it is the ſame whether the eye be leſs ſenſible to receive the impreſſion, as in the gutta ſerena; or is leſs ſenſibly impreſſed by the light being intercepted, as in the cataract: in both caſes the pupil becomes larger.

CCVIII.

Some have ſuppoſed that the motion of the eye was owing to the light ſtriking the iris, and affecting it; but it evidently depends upon the manner in which the retina is affected; for the pupil loſes its motion nearly as much in the cataract as in the gutta ſerena, or the two eyes ſympathize: ſuppoſe one eye is diſeaſed, and that the pupil is little affected by imitating it; yet, upon opening the ſound eye, the irritation upon the one affects the pupil of the other, ſo the motion depends upon the affection of the retina.

CCIX.

Beſides the circumſtance of the eye adapting itſelf to the confuſion of objects, ſhews an inſtructive power, which is more extenſive than we are commonly aware of. We not merely contract the pupil, and allow it to relax itſelf by its natural tone, but we poſſeſs a muſcular ſtructure; not one that can be ſhewn by diſſection; indeed, we cannot ſhew a ſpincter for contraction, or fibres for dilatation, but we poſſeſs the power of contracting or dilating the iris beyond its tone. The contraction is known from the common effect of light;

but wherever the retina is uncommonly infenfible, by difeafe, the pupil is widened far beyond its natural tone; and, in perfons dying, the pupil is feen much larger than it was five minutes after death, which brings it nearly to the fame fize as when the eye is not turned to a very clear light, nor in too great obfcurity. But in the hydrocephalus and amaurofis it is greatly dilated. When the patient is aroufed by giving him hartfhorn drops, &c. the pupils are greatly dilated; and when the ftimulus is made by light, upon bringing the candle near the eye, the pupil opens fo wide that the colour of the iris is fcarcely to be diftinguifhed. It has been accounted for from mechanical irritation; but when the patient is roufed, there is an effort made to fee; the quantity of light is not fufficient to make an impreffion; therefore, by an inftinct of nature, there is an effort to enlarge the pupil; and immediately after death it contracts to a much fmaller fize than it appears in thefe difeafes.

CCX.

Cornea and Sclerotis.

It remains to confider the external coats, the cornea and fclerotis. Whilft the cornea ferves the fame purpofe, by its pellucidity it tranfmits, and by its roundnefs it collects, the light; for the light is in a great meafure collected before it reaches the lens, that it may be accurately regulated by a

ſmaller motion; the light is brought into a very ſmall pencil of rays, ſo that the iris, by a very ſmall motion, exactly regulates what is neceſſary. The eye is ſupported in its place by the tunica adnata vel conjunctiva, which is produced from the eye lids doubled; and we trace it over the eye, even making a part of the outer layer of the cornea, though it is not ſeparable by diſſection, but it is laid more looſely over the ſclerotic coat, and many veſſels run here, ſo it is ſubject to inflammation, which often extends over the whole eye, and the whole very ſenſible ſubſtance of the cornea is covered with veſſels, and we often find ſpots produced upon it. Where the veſſels are very deep, there may be a dilation of the natural veſſels; but in 99 caſes of 100 they are a new growth, beginning in the ſclerotic coat, and gradually extending over the cornea, as in the caſe of a loſs of ſubſtance or wound; and we may trace them with the eye over the coat, and theſe arteries meet again with veins to return the blood.

CCXI.

The tears next are conducted to the puncta lachrymalia, and paſs down into the noſe, where they are poured out under the inferior os ſpongioſum. But, by what power are they taken up, and thus conveyed to the noſe?

CCXII.

The puncta have open mouths, which are supported by a ring of hard cartilaginous matter, and the ducts gradually enlarge, and end in the lacrymal one. It is evident that the tears are not pushed into the puncta by force, for pressure makes them run over the cheek; so they must be sucked in by that power inherent in small capillary tubes; and they are thus conveyed a certain way. We shall suppose that this power is sufficient to fill the ducts altogether; that the whole sac and ducts are filled by attraction, which is, perhaps, not true. We cannot suppose the motion continued; it does not empty these again; for, supposing the supply cut off, the duct remains full, because the same power that draws the tears into the ducts, if no more tears are added, prevents the emptying. There is an attraction that would suspend the tears within the ducts; but, if more fluid is added, it comes to represent the common syphon in its operation, and there must be a muscular power in the holes to push on the liquor.

CCXIII.

From this view of the general structure of the eye, it appears that its first coat, or tunica adnata, connects the eye by its thin pellucid membrane to the orbit, and protects it from the irritation of extraneous bodies. Its next coat, or the cornea, hard and dense, forms its anterior covering, is

more convex than the reſt of the ball, and is joined to the ſclerotica as the ſegment of a ſmall ſphere to that of a larger one, containing the aqueous humour within its membrane. The convex iris compoſes a tranſverſe ſeptum, floating in the aqueous humour between the cornea and ſclerotica, with a middle perforation for the pupil. The iris, on its back part, diſplays a dark coloured pigment, termed the uvea; on removal of which, its ſtructure conſiſts of two ſets of fibres; one radiated, of various colours, and giving the particular colour to the eye; the other circular, and forming the ſpincter muſcle of the pupil, which regulates its motions as influenced by the impreſſion of light made upon the retina. The ſclerotic, the next coat, is firmly fixed to the edge of the cornea, and is the moſt extended and ſtrongeſt membrane of the eye, with fibres running in every direction. Its inner ſurface is in contact with the choroid coat, the connection being formed by veſſels, nerves, and cellular ſubſtance. This thin coat, entirely vaſcular, is of a duſky brown colour, having on its inſide a dark coloured mucus or pigment, which gradually diſappears, or becomes lighter in its courſe towards the optic nerve. The connection of this coat at its fore part, and the former, and alſo of the iris, is made by condenſed cellular ſubſtance in the form of a ſhining cord, termed the ciliary ligament or circle, oppoſite to

which is a black radiated ring, confifting of ciliary plicæ, or proceffes, and ftriæ, named the corpus ciliare, and compofed of the continuation of the veffels of the choroid coat. The optic nerve in its courfe through the orbit, is covered by its membranes from the brain, but after its ingrefs through the fclerotic coat, it expands to form the retina. The retina is a tender pulpy fubftance, femi-tranfparent, and of a light grey colour, varying in its equality and thicknefs, in different parts advancing between the choroid coat and capfule of the vitreous humour to the fore part of the eye, and terminating upon the anterior edge of the chryftalline lens.

CCXIV.

Of the humours, the aqueous is lodged in two chambers or cavities. The anterior is fituated between the cornea and iris, and the pofterior between the iris and chryftalline lens. The chryftalline lens placed behind the aqueous humour, is oppofite to the pupil, and lodged in a depreffion on the fore part of the vitreous humour. It refembles, as already noticed, a burning glafs. It varies in figure and colour at different periods of life, is compofed of concentric lamellæ placed over each other, and the firmnefs of its fubftance increafes as it advances to the centre. It is furrounded by its proper capfule, or covering, which is fo elaftic that its puncture readily allows the

disengagement of the lens. The vitreous humour fills the space from the chrystalline lens to the entrance of the optic nerve at the bottom of the orbit, and is concave before and convex behind. Its space is equal to $\frac{9}{10}$ of the eye. Its structure consists of delicate cells communicating with each other, including the liquor; and on its surface there is a transparent smooth coat, termed vitrea. To the vitreous humour the lens is fixed by an external circular lamina, inserted into the fore part of its capsule, termed the zonula ciliaris.

CCXV.

While the aqueous humour is on evacuation easily renewed, and while the chrystalline lens can be also displaced, and vision preserved, the loss of the vitreous humour is inseparable from the functions of the eye, and cannot at any time be renewed.

CCXVI.

To conclude our demonstration of the eye, its circulation still remains. This it derives from the carotids. The lids are supplied by the frontal, fascial, and temporal arteries; and these arteries again communicate with those within the orbit.

CCXVII.

The ocular, or ophthalmic artery, passes through the optic hole along with the nerve; and though in size no bigger than a crow quill, from it a considerable number of arteries arise, for it supplies

not only the eye itſelf, but all the appendages of the organ. Thus, it firſt ſends a branch which takes its courſe outwards and inwards along the eye to ſupply the lacrymal gland, where it is exhauſted. It next gives circulation to the organ itſelf, by means of a branch perforating the optic nerve, and diſtributed upon it; and alſo by means of the ciliary arteries, which go inwards to the fore part of the eye, where the ciliary circle lies. It then ſupplies the muſcles by means of an artery proceeding from the ſame ſituation as the ciliary. Two arteries then paſs from the ſocket through the ethmoid bone to the noſe; and, laſtly, the branches which are ſpread on the forehead and noſe proceed directly from the ophthalmic trunk.

CCXVIII.

With theſe arteries, as elſewhere, the veins correſpond; and they, at the ſame time, communicate partly with each other, and paſs partly to the external jugular vein and branches ſituated about the fore part of the orbit, and partly to the internal jugular vein of the cavernous ſinus.

CCXIX.

That the eye may properly execute its functions, it is neceſſary that the rays of light be fully collected on the retina, and meet in one point or focus; and to effect this, a due convexity of the cornea and lens muſt always take place. When

too great prominence prevails, the rays become too ſoon collected, and viſion is indiſtinct from this cauſe, or people are ſhort-ſighted. Where an exceſs of flatneſs is conſpicuous, the reverſe of this enſues, and only an indiſtinct focus is formed, as in the caſe of age. The motions of the iris and the muſcles of the eye, regulating the preſence of light, and determining by their action the length of its axis, enable the organ to accommodate itſelf to the diſt[illegible]ce of objects.

IX.

Chemical An[illegible] the Cranial Secretion.

The thin vapor or [illegible] contained between the dura and pia mater, and alſo in the ventricles of the brain, ſeem in its conſtituent principles to be compoſed of carbonated hydrogen gas and water.

Vaſcular Preparation of the Head.

In order to ſhew the circulation of the head, the latter ſhould be ſeparated from the body about the 6*th* or 7*th* vertebra. A pipe is then to be fixed in each carotid artery, or they may be both injected at the ſame time, and the injection ſhould be red. The jugular veins are alſo to be filled in the ſame manner, with a yellow injection, the cervical veſſels being previouſly ſecured by ligature, to prevent its eſcape.

When the injection is finiſhed, a part of the jaw bone muſt be removed to ſhew the courſe of the internal carotids, and it ſhould be behind the laſt molar teeth. On one ſide, the muſcles ſhould be diſſected away between the cervical vertebræ to ſhew the courſe of the

veſſels; and, on the other ſide, they ſhould be only cleared of fat and cellular ſubſtance.

The external view being thus ſecured, ſections are to be made of the ſummit of the cranium to ſhew the internal parts, and that in various ways, according to the purpoſe intended by the anatomiſt. A ſaw muſt be uſed to accompliſh this, and the membranes, on removal of the bone, are to be divided by a knife or ſciſſars.

Chemical Analyſis of the Eye.

The quantity of the aqueous humour is 4 or 5 grains, but it varies in different caſes; by ſmell in the fœtus, in age, and in dying; but it is more quickly repaired when deſtroyed, than any other fluid in the body. Its principles conſiſt of water with animal hydrogen gas, and ſometimes a ſmall proportion of ſoda, and muriat of ſoda.

The chryſtalline lens, in gravity, is equal to 4 grains. By its maceration in ſpirit of wine, or vinegar, it ſeparates laminæ like the leaves of a book, ſeparable from each other by a ſcalpel. In acids it is rendered opake, and condenſed by congelation.

The vitreous humour is heavier than common water, and bears a proportion to more than two thirds of the weight of the eye. It reſembles a ſingular ſpecies of tremulous jelly. It is rendered turbid by moſt other ſalts but the acetous acid.

The pigment, or coloured mucus of the iris, differs in its two ſurfaces. In the poſterior ſurface it is always black, but in the anterior it is various. In cold countries it is bluiſh, or of a pale aſh colour. In warm

regions it is of a dark chesnut or black hue, and various shades are sometimes observable in different parts of the same eye.

The constituent principle of this pigment is animal mucus, mixt with a peculiar colouring matter.

The pigment of the choroid membrane is of the same nature, and answers the same purpose.

The tears, or lacrymal secretion, is an aqueous liquor, saltish to the taste, and in quantity only moistening the eye, but capable of being increased to great extent from any irritation or stimulus applied to the organ, so as to overflow the eye, and pass down by the cheek.

The constituent principles of this secretion are;

1. Water, in great proportion.

2. A peculiar kind of mucilage.

3. Muriat of soda, phosphate of lime and of soda, and soda in a caustic state.

Hence their inspissation by the absorption of oxygen from the atmosphere.

The secretion of the eyelids is an oleaginous mucus, not soluble in water, and inspissated by the oxygen of the atmosphere. When mixed with the tears, it forms a kind of glue, cementing the lids together.

The mucus of the caruncula lacrymalis and lacrymal sac, is of the same nature.

CCXXI.

After having seen the brain, and its expansions on the eye, we are next to pursue its different prolongations as they proceed from the cranium, and constitute the nerves.

CCXXII.

The firſt pair is called the olefactory; it paſſes through the cribriform bone, and is divided into a number of ſmall branches without receiving any firm covering from the dura mater; and the ethmoid bone, within the noſe, is compoſed of a number of cells, that the nerve may be divided as much as poſſible, becauſe there muſt be a certain diviſion of parts before the ſenſation can take place, as in the eye, where the nerve is inſenſible at its entrance.

CCXXIII.

Next, we ſee the optic nerve united; the nature of the union has been already explained, that the threads actually decuſſate one another. This connexion has been ſuppoſed to account for the uniform motion of the eyes; but we need only to obſerve that the optic nerve, does not terminate on the organs for the motion of the eyes, it is merely a nerve for ſenſation. When we proceed to trace the optic nerve, we ſee the medullary ſubſtance ſpread out into an uniform coat, and there is no reaſon to imagine any kind of motion has been inferred.

CCXXIV.

In this ſoft and fine ſubſtance called the retina, the nerve muſt be ſpread out, and it terminates in

exceeding minute parts. From the ſmallneſs of the picture we would infer, that the diameter of one of the threads does not exceed the twenty thouſandth part of an inch, ſuppoſing that the picture occupies but a ſingle thread; but the probability is, that a number of the threads are affected by every picture at the ſame time; we ſee, therefore, that there may be numerous nerves diſtributed to parts, though we are not able to trace them.

CCXXV.

The third pair of nerves is called oculi motor, ſupplying many of the muſcles of the eye; we find likewiſe produced from that nerve ſmall threads, which join to ſupply the iris.

CCXXVI.

The next pair, the fourth, is ſingular in every circumſtance. In its origin, which is very diſtinct from the teſtes, and from the origin of the third pair, which is a nerve of the brain, and the other of the cerebellum, and it terminates in a ſingle muſcle, the trochlearis. Some think that it is the chief inſtrument of expreſſing the paſſions of the eye, ſo it receives a thread undivided; but obſerve only the diſtribution of the third pair. We find a muſcle co-operating ſupplied by a common root, and the third ſupplies the attollens and deprimens oculi, which are antagoniſts; ſo we would

leave this as a circumſtance that we cannot explain. Where nature is uniform, the diſtribution is intended for ſome wiſe purpoſe; but in the preſent inſtance that lies concealed.

CCXXVII.

The fifth is the largeſt nerve of the cranium, and is ſoon ſpread out into a conſiderable branch, which is ſeparated into three diviſions. The firſt and ſecond ſend ſome branches into the noſe, and other branches ſupply muſcles, ſo it ſerves both for motion and likewiſe for ſenſation; and the third branch ſerves not only for ſenſation on the point of the tongue, but taking its courſe towards that point, it ſupplies the muſcles of that organ, and branches are ſent to the maxillary and ſublingual glands, to regulate the ſecretion of the ſaliva. Now, though certain nerves, as the olefactory and ophthalmic, have a greater whiteneſs than we obſerve in the other nerves; yet, in the fifth pair, the branches ſupplying the ſenſes have the ſame colour as thoſe deſtined for motion, and hence we conclude that all its offices are performed by the ſame medium. Thoſe nerves intended for more diſtant parts are expoſed to injury, and receive, perhaps, an addition of the nervous influence from the coats that cover the proper nerves.

CCXXVIII.

When we now look back to the origin of the five firſt pairs, we find that the firſt, ſecond, and third pairs are nerves of the brain, whereas the fourth and fifth are almoſt entirely derived from the cerebellum, yet ſimilar offices are done by both. The firſt and ſecond are organs of ſenſe, the third of motion, the fourth of motion, the fifth of ſenſe, motion, and for aſſiſting in regulating the ſecretions; ſo that there is no reaſon for imagining that the offices of the brain and cerebellum are ſo very different as ſome phyſiologiſts have pretended.

CCXXIX.

The fifth joins the third, forming a ſmall ganglion. The only remark to be made upon it is, that we ſee ganglions in theſe parts which ſerve the moſt material purpoſes.

CCXXX.

The ſixth pair is ſpent upon the abductor muſcle, for a reaſon we do not pretend to underſtand, why the third might not have furniſhed the abductor as well as the other recti.

CCXXXI.

In its courſe, we perceive the connection made by two diſtinct threads which form the beginning of the intercoſtals; for it is abſurd the diſpute about the courſe of theſe, whether it is upwards

or downwards, whether they come from or go to this nerve. If they come from the intercoſtals, we have no origin to that nerve; beſides, we conſtantly obſerve that the ſixth pair becomes ſmaller betwixt this place and the eye; ſo theſe, with the branches from the fifth pair, are the higheſt origins of the intercoſtal or ſympathetic nerves.

CCXXXII.

The ſeventh is divided into two portions, one of which is without a covering, becauſe it is in no danger of being tore, and is called the portio mollis of the auditory nerve; but the other branch, running outwards, receives the covering from the dura mater, and is called the portio dura. And as we have found more than one nerve ſupplying material organs, the portio dura is joined by a branch from the ſecond of the fifth, and we find a nerve connecting it to the ſecond and fifth; and there is no doubt with regard to the chordæ tympani, that they are from the portio dura; and that the point of the tongue is ſupplied by the fifth in two places joined to the ſeventh; ſo that care is taken that we may not want the ſenſation of the tongue.

CCXXXIII.

Purſuing the portio dura, we find a very great number of branches ſpent upon the face. We may venture to allege, that the number is greater

here, in proportion, than what is ſpent upon the other muſcles, becauſe the muſcles of the face perform a double office; they not only ſerve for the motion of the lips, but for expreſſing our paſſions; and our nerves are large in proportion to the exerciſe of the motions of the organ in which they terminate.

CCXXXIV.

The portio dura is joined to other nerves; but the branches, inſtead of forming continued canals, paſs over each other; and where a muſcle is ſupplied, it receives a thread from each of the nerves: ſo we find a greater care taken to prevent theſe from loſing their power than moſt of the other muſcles, becauſe of the importance of their office. Thus, if we can open and ſhut the mouth with half the natural force, it is better than that we can open and not ſhut it.

CCXXXV.

The next pair going very far downwards, is named par vagum. It ſupplies the larynx; and as the function of that organ is material to life, ſo every precaution is taken to guard againſt accidents; hence there is a ſuperior linguæ, and a recurrent ſent back in a very particular manner. And, in endeavouring to determine the final cauſe, it is found that the voice is not loſt by cutting one of the nerves, though the recurrent. The

ſeveral tones, indeed, and the general ſtrength of the voice is diminiſhed, but it is by no means loſt.

CCXXXVI.

The ninth pair, like the fifth, ſupplies firſt the muſcles, and then the organs of ſenſe, and likewiſe the ſecretions; for from the ſurface of the tongue there is a conſiderable ſecretion of mucus.

CCXXXVII.

Noſe.

In this diſtribution of the nerves, we find the firſt pair diſtributed on the noſe.

This organ conſiſts of two parts, a hard and ſoft one. The hard part, or bony ſtructure, was formerly examined; and, at its under and fore part it conſiſts of five cartilages, of which one is ſituated in the middle, and the other four laterally.

The middle one ſupports the reſt, and conſtitutes the ſeptum, or diviſion of the noſtrils.

CCXXXVIII.

The lateral cartilages are placed two anteriorly, forming by their curved union the top of the noſe; and two behind, which compoſe the alæ naſi, and between theſe are ſmaller ones of various ſize and figure. Theſe cartilages are moved in different directions by the muſcles formerly deſcribed, and over the whole is thrown the common teguments, which are perforated at the under and outer part by large ſebaceous glands.

CCXXXIX.

The internal cavities of the noſe extend upwards to the cribriform plate of the ethmoid, and to the body of the ſphenoid bone. They are bounded by the middle partition, partly of bone, and partly of cartilage; and, on the outſide, the ſpongy bones project into them, and increaſe the ſurface of the membrane.

CCXL.

The bottom of the noſtrils runs ſtraight backwards, admitting the paſſage of a probe into the throat, and the fore part is defended by ſtiff hairs which detain the mucus, and prevent the entrance of external irritation.

CCXLI.

The cavity of each noſtril has been divided into three paſſages, a ſuperior, middle, and inferior one. The firſt aſcends to the upper ſpongy bones, the ſecond to the junction of the ſuperior and inferior ſpongy bones, and the third from the termination of the inferior ones to the bottom of the noſe.

CCXLII.

Theſe cavities are every where lined with a thick ſpongy membrane, which is continued likewiſe over all the adjacent parts, which is highly vaſcular and nervous, and conſtitutes the primary organ of ſmell, having its ſurface kept conſtantly moiſt and lubricated, with a mucous ſecretion from its numerous follicles.

In this cavity of the nofe all the finufes of the cranial bones terminate, and the fame covering extends over them as extends over the nofe, but it is thinner and lefs vafcular. This termination of the cranial finufes feems particularly intended to increafe and modulate the voice.

CCXLIII.

In this cavity of the nofe likewife terminates the lacrymal fac and incifive duct. The firft was already noticed in the Ofteology. It is a membranous canal, the duct of which ends in the inner and fore part of the antrum maxillare. The fecond is a fmall canal, or paffage in the foramen incifivum, which is not only open in the fkeleton, but in the natural ftate of the body, though in many fubjects it is entirely fhut. Its office is to convey the tears from the nofe into the mouth; for the tears dropping from the lacrymal duct, when the head is in an erect pofture, fall into that canal.

CCLXIV.

The circulation of the nofe is fupplied chiefly from the branches of the external carotids. The outer part receives certain divifions of the facial, and of the internal maxillary arteries, while the inner draws its circulation from the internal maxillary artery, and fmall branches of the ocular arteries. Its veins again terminate in two ways, either in the external jugulars, or by communi-

cating with the ocular veins, their circulation paffes into the lateral finufes and internal jugulars.

CCXLV.

The nerves of this organ, or of the internal part of the nofe, are principally the olefactory, or 1*ft* pair, affifted by fome branches from the 1*ft* or 2*d* portions of the 5*th* pair, while the outer furface draws its feeling not entirely from the fame fource, but from the 2*d* branch of the 5*th*, and from the portia dura of the 7*th* pair.

CCXLVI.

Chemical Analyfis of the Nafal Secretion.

The quantity of this fecretion is very various; when thin, it is pellucid; but when thick, it is otherwife, and mixt with various matters. In confiftence it is vifcid and ropy, adhering to all bodies. It is mixed more or lefs with two other excretions, an aqueous fluid from the finufes, and the lacrymal fluid. At its firft fecretion it appears analogous to the tears, but it changes by its ftay in the nofe, abforbing probably oxygen from the air, and having the carbonic acid of the expired air faturating its uncombined foda. Of all the animal fluids, it is the leaft fubject to putridity, and it may be kept for any length of time without producing any fœtor.

CCXLVII.

From the demonftration of the nofe, we are directed naturally to that of the mouth, the offeous and mufcular parts of which have been already defcribed.

CCXLVIII.

Mouth.

We begin, therefore, with the lips and cheeks, which, beſides their muſcles, conſiſt only of the external teguments and the internal covering, lined with mucous glands.

CCXLIX.

This membrane is covered with fine villi, moſt conſpicuous on the edge of the lips, eſpecially by a fine injection, or by macerating them till the ſeparation of the cuticle. On entering the mouth, the gums next appear as formerly deſcribed, (Vol. I. CCV.); and, on leaving them, we are next directed to the palate and tongue.

CCL.

Palate.

The palate conſiſts of two parts, the bones already demonſtrated (Vol. I. LXXXVI.) covered by the perioſtæum and villous membrane of the mouth, diſtinguiſhed here by numerous rugæ, intended to aſſiſt the diviſion of the food, and to increaſe the force of its preſſure againſt this part in order to extend the powers of taſte, and the ſoft parts, or velum, forming a partition between the mouth as formerly deſcribed, (Vol. I. CCCXXII., &c.) and compoſed of the membranes which line theſe parts beſet with mucous glands, and its own muſcular expanſions which enable it to act in ſwallowing, as a valve, on the noſe. From this part,

we alſo ſee its uvula or pap deſcend, a part of material uſe in deglutition and ſpeech.

CCLI.

Tongue.

The tongue, the next object of our attention, is of an oval form, and divided into three parts, its baſe, its body, and its apex; and the compoſition of this organ, except its membrane and papillæ, conſiſts entirely of muſcles, already demonſtrated (Vol. I. CCCXXXV. &c.). The baſe of the tongue is connected, as we have ſeen, to the os hyoides (Vol. I. CCXCVIII.) and its body terminates anteriorly in the looſe moveable point. Its upper ſurface is divided by a middle longitudinal groove; and its inferior ſurface, ſo far as it extends backwards, is connected to the parts below by the ſublingual ligament, or doubling of the ſkin lining the mouth. Membranous ligaments attach its ſides to the lower jaw and adjacent parts.

CCLII.

The coverings of the tongue are three in number: the common teguments, kept moiſt by the ſaliva, and formed alſo into vaginæ for the papillæ; the corpus mucoſum, thicker here than any where elſe, but alſo preſerved in a moiſt ſtate; and the true ſkin, of a bright nervous texture, from which the papillæ of the organ proceed.

CCLIII.

Theſe papillæ are confined to the upper ſurface

of the tongue, and are moſt numerous over its apex. They are divided, from their ſize, into three orders. The *1ſt* are largeſt, have round heads and ſhort ſtems. They are placed more at its baſe in ſuperficial pits, and form, as it were, an angle with its point backwards; their ſecretion is of a ſalivary nature, proceeding from a perforation in the middle of each. Beſides theſe papillæ, numerous mucous follicles cover the ſurface of the tongue. At its root, alſo, there is a hole, which receives the mouths of ſeveral excretory ducts terminating upon it.

CCLIV.

The *2d* order of papillæ is of a cylindrical form, and ends in a round extremity, being ſcattered over the upper ſurface of the tongue, at ſome diſtance from each other.

CCLV.

The *3d* order is numerous and minute, extending over the apex; and to the former and this the impreſſion of taſte is chiefly aſcribed.

CCLVI.

The circulation of the palate is derived from branches of the facial, and internal maxillary artery, while its veins are directed to the external and internal jugulars.

CCLVII.

The circulation of the tongue is ſupplied from the external carotids, and the branches they be-

ſtow for this purpoſe are termed linguales, or, from their black colour under the tongue, raninæ. In proportion to the ſize of the organ, its veſſels are apparently large; and they have leſs communication with each other in the oppoſite ſides than in other parts of the body.

CCLVIII.

The nerves of the palate ariſe from the *2d* portion of the *6th* pair, with ſome twigs of the *8th*.

CCLIX.

Thoſe of the tongue are from the *5th*, *8th*, and *9th* pairs. They are large in the ſame proportion as the veſſels; and they have, likewiſe, little connection on the oppoſite ſides.

CCLX.

To finiſh the demonſtration of the mouth, its glands remain, which are three in number: the parotid, the ſubmaxillary, and ſublingual; all of a yellow colour, and of the conglomerate kind.

CCLXI.

The parotid is a large gland, named from its particular ſituation, and it occupies the ſpace between the ear, maſtoid proceſs, and angle of the lower jaw, extending to the zygoma and maſſeter muſcle, which it partly covers, and lying contiguous below to the ſubmaxillary gland.

CCLXII.

From different parts it gives out ſmall branches, which join in a large duct paſſing from the upper

and fore part of the gland; and the cavity of the gland is ſmall, proportioned to the ſize of this duct.

CCLXIII.

In its progreſs, it paſſes tranſverſely over the maſſeter tendon, where it receives ſome additional ducts from ſmaller glands; and deſcending, it perforates the buccinator muſcle, oppoſite to the 2*d* or 3*d* upper molaris.

CCLXIV.

The ſubmaxillary gland, rounder and ſmaller than the former, lies between the angles of the lower jaw and the digaſtric muſcles. From its upper and fore part ariſes a duct, thinner and longer than the former, which paſſing to the ſide of the frænum linguæ, terminates by a ſmall papillary orifice behind the inciſors.

CCLXV.

The ſublingual gland, oval and flat, is alſo ſmaller and ſofter than the laſt. It is ſituated under the anterior portion of the tongue, with its extremities forwards and backwards. It is covered by a continuation of the lingual membrane, fixing it in its place, and it opens on the outſide of the frænum by ſeveral ſmall orifices on a line with the gums. It ſometimes communicates by a branch with the ſubmaxillary ducts.

CCLXVI.

Beſides the glands deſcribed, a number of ſmall

ones are conſpicuous on the inſide of the mouth, ſituated between its inner membrane and the muſcles; and each of theſe perforate its cavity by a ſmall duct.

CCLXVII.

The circulation of the ſalivary glands is ſupplied by the external carotids. The parotid derives its ſupply from the temporal artery, the ſubmaxillary from the facial, and the ſublingual from the lingual artery, while their veins are returned to the external jugulars.

CCLXVIII.

The origin of their nerves is traced from the 3*d* part of the 5*th* pair, and from the portio dura of the 7*th*.

CCLXIX.

By theſe glands is the ſecretion of ſaliva made and poured out by their ducts in large quantity for the ſolution of the food, lubricating the parts, and aſſiſting digeſtion.

CCLXX.

Chemical Analyſis of the Saliva.

The ſecretion from the ſalivary glands is one of the moſt important to the animal economy. It is not leſs than to the amount of 12 lbs. in 12 hours, and it is conſiderably augmented either by irritation of the parts, as in maſtication, or ſpeaking, or by hunger.

The conſtituent principles of the ſaliva are;

1. Water, to the amount of $\frac{5}{4}$.

2. Albumen, diſſolved in the water.

3. Compound ſalts, conſiſting of muriat of ſoda and phoſphate of lime, as occaſional concretions in the ducts ſhew.

Saliva poſſeſſes an antiſeptic virtue, it promotes the ſpiritous fermentation of vegetable matter, it is diſſolved by alkalis, and it gives out, during the ſolution, ammonia.

Anatomical Preparation of the Parotid.

This gland ſhould be injected in its place from its numerous ſmall branches. To do this, the ſkin ſhould be raiſed on the ſide of the face from the ear to the mouth, and from the temporal muſcle to the neck, and in doing it the knife ſhould be kept cloſe to the ſkin ſo as to avoid the gland, and the fat and cellular membrane diſſected with much care from the maſſeter muſcle to find the duct about 2 inches long, and reſembling in ſize a crow quill. An opening is to be made into it with the point of a lancet, ſo as to introduce the point of the ſteel injecting pipe as far from the gland as poſſible; which, once introduced, is to be ſecured by a ligature with one knot. When the gland has received as much quickſilver as it can contain, the pipe is withdrawn, and the duct ſecured by ligature, after which it is to be carefully diſſected from its place, firſt ſecuring its numerous branches by a ſmall needle and ligature before dividing them. The gland removed is to be laid in a diſh, the extraneous parts about it removed, then laid in clean water for a day or two, after which it is to be ſpread on paſteboard and placed in the air to dry, after which it may be preſerved in a glaſs veſſel with oil of turpentine,

CCLXXI.

Having thus seen the structure of the nose, mouth, and tongue, let us examine the use of these parts, and the reasons of their structure, beginning with the sense which is exercised in the most simple manner.

CCLXXII.

Taste.

Very large arteries and nerves are observed to be sent to the tongue, which is necessary from the tongue being an organ of very considerable motion, and from exercising the sense of taste; besides which, from its surface there is a considerable secretion; for to the last purpose a great quantity of blood is essential: but a quantity of blood is likewise constantly found circulating in organs that perform a large motion, and still more in organs of sense. The reason of this, at first sight, is not so certainly evident; but there is reason to believe, that as the heart and brain act upon each other in a circle, we find ourselves at a loss to distinguish cause from effect; in like manner the arteries and nerves, in their progress, act upon each other. And there is further reason for believing that, in a manner not fully understood, the arteries tone the nerves for receiving their impressions, and conveying them distinctly. When we compare the tongue with the nose, we see this in a clear point of view.

In the membrane of the nofe, there are fuch a great number of veffels that circulate red blood, that we fhould be apt to imagine that thefe would prevent the diftinct impreffion of the nerves; but, on the contrary, they contribute to increafe the diftinctnefs of it; and in making experiments with medicines, how far they act by immediately influencing the nerves, this is apparent. Thus, after the circulation is interrupted in the courfe of the nerves, as the fciatic, though the organ is quite entire, medicines cannot influence the fyftem through that fingle branch after the circulation has ceafed, though they produce the moft violent fymptoms when applied to the correfponding nerve where the circulation is carried on; fo that the arteries actuate the nerves in their progrefs fomething more than merely by giving them a certain degree of tenfion; and, in like manner as we find the arteries affift the nerves in their office of fenfe and motion, the nerves affift the arteries in performing their fecretions. Hence it may be alleged, that the numerous nerves of the tongue not only are intended for motion and fenfe, but for regulating the fecretions made from the extremities of the arteries.

CCLXXIII.

In exercifing the fenfe of tafte, we apply faline fubftances, which are divided upon the furface of the tongue; and, if we do not perceive the im-

preſſion, we preſs the tongue againſt the palate; not that the palate is the principal organ of taſte, for, upon rubbing the body of the tongue againſt the palate, we have no diſtinct impreſſion, but the effect is to make the greater impreſſion upon the tongue: whether the ſeveral papillæ are rendered more ſenſible, is uncertain. The ſwelling of the papillæ of the tongue, upon irritating them, has been obſerved by ſome; and there is probably a filling of the veſſels in order to give a greater ſenſibility to the part.

CCLXXIV.

The noſtrils are alſo ſituated, that we may ſmell ſubſtances at the ſame time that we taſte them; and they do not receive the current of the atmoſphere, but the current of air aſcending from the roof of the mouth. When the air enters the noſe, inſtead of running in the moſt direct manner into the throat, it riſes upwards to the top of the noſe, to the oſſa ſpongioſa, which are the principal part of the organ of ſmell; for, upon examining a variety of animals, the acuteneſs of ſmell varies with the extent of the ſurface of theſe bones; and, in a dog, they are extremely convoluted; and from thence we underſtand the reaſon of the name of turbinatum.

CCLXXV.

But is it to be imagined that the ſinuſes, or larger caverns that communicate with the noſe,

contribute to increaſe the ſurface of the organ of ſmell? or is it to be ſaid that the membrane lining the ſinuſes ſupplies the moiſture to the noſe, to prevent it from being dried by the current of the air? We do not ſee that the ſinuſes are neceſſary in order to ſupply a ſufficient quantity of moiſture; for if, in inſpiring, a great deal of moiſture is carried away, at the next moment, when we expire by the ſame paſſage, we not only return through the noſe all that we took from it, but the addition of the vapour brought from the lungs.

CCLXXVI.

Some of the ſinuſes, alſo, have the opening at the top. If theſe were filled with moiſture when we are ſome time in an erect poſture, upon bringing the head forwards we ſhould ſee it diſcharged; and the ſinuſes being filled with water, would counteract one of the main purpoſes of the ſinuſes, the effect they have upon the voice. And with no better reaſon are they ſuppoſed to extend to the organ of ſmell, for children ſmell as acutely as adults, and yet in them the ſinuſes are only beginning to form. It is uſe that, in a great meaſure, extends them continually as they advance in life. There is, no doubt, a diſpoſition in the bone to enlarge; but they are increaſed by uſe. And this conſideration, alſo affords an argument againſt their being intended to ſupply the noſe with moiſture, for children have rather more moiſture than adults,

though the ſinuſes are only beginning to form. Beſides, comparing a variety of animals, the appearance of the ſinuſes does not vary with the acuteneſs of the ſmell; but the variation is within the open cavity of the noſe. On attending, alſo, to what happens in ourſelves, the openings are not moſt favourable for receiving the air in inſpiration, when we ſmell moſt acutely; and if the membrane of the ſinuſes feels very acutely in drawing in a pungent ſubſtance, we ſhould be ſenſible of pain in this as well as in the noſe; for it has been alleged, that we do feel pain in the root of the noſe; but whether is it in the os ſpongioſum ſuperius, or in the ethmoid bone, or a little higher? The pain evidently does not extend further than the root of the noſe, and never above the eye; and the antra maxillaria are extremely large, and yet we never find a violent pain in the cheeks in drawing in odours into the noſe; and, as an irreſiſtible argument, it may be obſerved, that in the time of inſpiration, or ſmelling, the air does not enter the ſinuſes, but comes out of them. A ſmall ſtream from the ſinuſes entering the lungs along with the external air, (the air in the lungs being now lighter than from the ſinuſes,) enters them for the ſame reaſon the external air does. And if we find ſmall particles of duſt within the ſinuſes, theſe are puſhed in from the open cavity in the

time of expiration, the air rushing where there is a vent, endeavouring to expand on all sides, it enters the sinuses.

CCLXXVII.

It is therefore to be said, that the membrane being thin, and the bones hard, such a tremor is produced as renders the voice louder, and more harmonious. The use of sinuses may be, indeed, confined to this last purpose; and that they serve this purpose, appears from a variety of considerations. The voice is formed at a certain age, as the sinuses form; and we find, that when the membrane of the nose is thickened, the voice becomes harsh and disagreeable. Or, comparing the sinuses with a drum, we find a great analogy between them. Take the antrum maxillare, there is an impression made on the side of it, and it is shut by membranes resembling the parchment of the drum, and the opening in that instrument. And apply the finger to it in the time of speaking, you will be sensible that all the bones are at that instant under a tremor.

CCLXXVIII.

The last part of the head that awaits our examination is the ear.

CCLXXIX.

Ear.

The skin of the external ear, or ala, is supported by cartilage. It is divided, at its fore

part, into ſeveral cavities; and, beſides the muſcles connected with the head, the ſuperior attollens aurem, &c. there are a few very ſhort and very pale coloured muſcular fibres, which begin and end on the external ear, and which are already demonſtrated (Vol. I. CCCXXXV).

CCLXXX.

Of the ala, the outer bar, or margin, is termed the helix, from its bending direction; and it divides the concha into two parts. The inner bar, or margin, termed the antihelix, conſiſts of two ridges, placed within the former, that unite below. Over the external paſſage is a ſmall eminence, the tragus, connected to the under and fore part of the helix, and is diſtinguiſhed by the hairs that grow on it. Oppoſite to this is the antitragus, then the nameleſs cavity ſituated between the helix and antihelix, next the ſcapha, or boat-like part, between the limbs of the antihelix, and following that is the concha, or cavity under the antihelix, the inferior part of which leads to the meatus auditorius.

CCLXXXI.

From this part there is a paſſage inwards, the outer half of which is compoſed of the ſame materials as the external ear; but the inner half, in the adult, is oſſeous. In a child, the whole paſſage is ſoft or cartilaginous, and the bone only by degrees encroaches upon the cartilage.

CCLXXXII.

At the bottom of the external paſſage, which is lined by a fine membrane, we find wax, or a bitter ſubſtance like bile inſpiſſated, and which is ſeparated from minute glands. This membrane is ſemi tranſparent, looks like a bit of the pleura or peritonæum when wetted with water, and veſſels are obſervable upon it. This membrane has no hole within it, but we find a large irregular ſhaped cavity, about the ſize of the laſt joint of the finger. That cavity is compared to the cavity of a drum; and therefore the membrane which is found covering it, is compared to the parchment of a drum, or named membrana tympani.

CCLXXXIII.

There is no paſſage then for air through the external meatus into the cavity of the tympanum, but there is a direct paſſage into it leading from the throat. The tube is named tuba Euſtachiana, and it is of the ſhape of a trumpet, with the ſmall end towards the ear, and, like the external meatus, the firſt half is cartilaginous, and the other half, towards the ear, oſſeous. The part on which the impreſſion of ſound is made, is at the bottom of the cavity of the tympanum; but a connection is made between this and the membrane of the drum by a very curious chain of bones, four in number, and termed the malleus,

incus, orbiculare, and ſtapes. The fourth, or the ſtapes, is connected to a membrane, with an oval hole at the bottom, ſo named foramen ovale. Within that we find an enlargement of a cavity, and from that the ends of five, or rather ſix, ſemicircular hollow tubes. The enlarged cavity, in which they terminate, is named veſtible, and the canals begin and end in it. Two of theſe canals are joined, and hence there are only five openings.

CCLXXXIV.

There ſtill remains one curious organ, like the ſhell of a ſnail, and therefore called cochlea, and this is turned round a gland. The bottom of the ſhell, which is a hollow tube, communicates partly with the veſtible; but the outer half terminates at a round hole ſhut with a membrane on the back of the cavity of the tympanum, and we find a partition dividing the cochlea the whole length.

CCLXXXV.

It is in theſe laſt named parts, the cochlea ſemicircular canals and veſtible, the portio mollis of the ſeventh pair of nerves terminates, ſpread out upon the membrane which lines them; and here, at laſt, the impreſſion of ſound is ultimately made, juſt as the impreſſion of light is made upon the retina of the eye.

CCLXXXVI.

The chain of bones which play upon one another, is not merely formed by membranes, but small muscles are likewise connected to them. An external muscle has been mentioned as at the bottom of the meatus; but this is hardly to be found. But there are three others; one of them follows the course of the Eustachian tube, and is connected to the malleus, which it draws a little out and nearer to the middle of the head. It lies parallel with a nerve, the branch at the root of the lingual branch of the fifth pair, and it passes through the cavity of the tympanum like a stretched chord, so called corda tympani; the fibres of the muscle are parallel, and a branch of the portio dura can be traced into it.

CCLXXXVII.

From this general view of the several parts, their use, and their manner of operating, fall next to be considered. First, we observe, that danger is guarded against; pointed instruments are hindered from entering the external cavities to the membrane of the drum, partly by the protection which the prominence, named tragus, gives to the passage; if we mean to stop the external passage, we press our finger upon the prominence. And the passage is not altogether straight, but a turn is made where the cartilaginous part joins with

the oſſeous. This turn, however, is by no means ſo great, but that, by pulling backward the cartilaginous part, we are able to ſee to the bottom of the paſſage, and with the light of the ſun to diſtinguiſh the membrane of the drum. Inſects are hindered from readily entering, by the number of ſmall hairs from the ſides of it, and the very viſcid wax, which is the chief or primary purpoſe of the cerumen, for it is not of any immediate conſequence to fit the ear for receiving the impreſſion of the ſound.

CCLXXXVIII.

In like manner, the internal paſſage, the Euſtachian tube, is guarded. There is little fear of our food or drink being ſqueezed into it in deglution, for without ſuppoſing a contraction about its orifice, ſomewhat of a muſcular power inherent in its membranes, the mouth of it is placed higher than the velum pendulum palati, and it is accurately ſhut by the elevator palati, and by the ſuperior conſtrictor of the pharynx.

CCLXXXIX.

Proceeding then to the particular parts of the organ, we obſerve of the external ones, that the cartilage under the ſkin ſerves to enlarge the tube in which the tremor of the air is made. Not that we can demonſtrate that the human ear is exactly formed for collecting every tremor; for, in attempting to aſſiſt the dullneſs of hearing, we find

other contrivances equally good, and we obferve a great variety with refpect to the fhape in different animals, fome of which hear more acutely than we do; but, by attending to the fhape and winding of the paffage, it is obvious that the found reverberates as it is thrown into the meatus; and we have feen mufcles of the head connected to the ear, which at leaft ferve to give a tenfion to the part. Other animals affift their hearing by thefe mufcles, pointing the bone of the ear towards the fonorous body, whereas we are under the neceffity of moving the whole head, fo that the direct impreffion is made upon one ear only, and there is no communication between the ears, as in a bird, which receives the direct impreffion upon both ears at the fame time, a canal leading from the one to the other. The fmall mufcles upon the cartilages ferve alfo to give a greater tenfion, and to throw off the found with an additional force.

CCXC.

Within the meatus auditorius externus, the found is collected and concentrated, and the winding paffage, inftead of leffening, increafes it, juft as a found appears louder in a crooked paffage made by walls, than if the paffage is altogether ftraight. Perhaps, the found is thrown by the fides of the paffage towards the middle of the concavity to the very place where the bones are

connected to the membrane, for it is the chain of bones that pulls the membrane inwards. Through the chain of bones the found is communicated to the membrane of the oval hole or veftible; *i. e.* to the three femicircular canals, and at leaft on one half of the cochlea; but the turns which the organ makes communicating, the whole cochlea and femicircular canals through the veftible are affected.

CCXCI.

Since the fmall bones have mufcles joined to them, it muft be admitted that they ferve to regulate the tenfion. And as in other animals the mufcles of the external ear are fpontaneoufly roufed into action, fo the internal ones are influenced likewife in the fame manner. Nay, this may be carried farther; for they not only act when the found is very low, and the tremor is not diftinctly communicated, but alfo a tenfion of the chord is made with the found, being thus more readily communicated to the chain of bones and to the membrane of the oval hole.

CCXCII.

Befides this, a general vibration is communicated alfo to the air within the cavity of the tympanum, and which is conveyed there by the Euftachian tube; for, unlefs the tremor had affected the air in general within the cavity of the tympanum, that paffage might have been wanting. If it was only neceffary that the found

ſhould be conveyed through the chain of bones, there was no neceſſity for air within the bones; and there is no doubt, that were the ſmall bones taken out, without a læſion of the parts, ſtill we ſhould be able to diſtinguiſh the variety of ſound.

CCXCIII.

On conſidering the irregular ſhape of the cavity, and the communication it has with the cells of the maſtoid proceſs, it might be ſuppoſed that the former purpoſe of collecting the ſound was contracted by its being diffuſed in a cavity of ſuch extent; but the ſides of it are made of hard bones fitted for tremor, and the outlet is ſmall. Thus a ſtriking analogy is afforded between this part of the ear and the common inſtrument, the membrane reſembling the parchment of the drum, the cavity within, and the Euſtachian tube, the cavity and holes in the ſide. As the ſinuſes, communicating with the noſe, increaſe the voice, and render it more melodious, ſo the ſame thing may be applied to the ear; and, if a tremor is communicated by the cavity, the ſound in that manner is increaſed, and applied through the ear to the bottom of it. And this is a ſecond manner in which we receive the impreſſion; and one half of our cochlea terminates at the membrane ſhutting the foramen rotundum, and has no immediate connection with the chain of bones.

CCXCIV.

A third manner of communication has been ſuppoſed, that the tremor is communicated to the parts within, directly through the Euſtachian tube, ſerving the ſame general purpoſe with the external.

CCXCV.

Thus, there are two chief ways in which we receive the impreſſion of ſound: one through the chain of bones, the other through the membrane of the tympanum and the air in the cavity. There is another way, that has no inconſiderable effect, the general tremor of the bones of the head and of the whole body. So perſons in whom the external ear is corroded, and the chain of bones perhaps deſtroyed, diſtinguiſh very loud ſounds in this way; and if you apply any tremulous ſubſtance to the jaw bones, as ſtriking the grains of a fork, you hear as it were a very loud ſound. The common account here is, that the nerves are connected, ſo the tremor paſſes from one nerve to another; but ſtill the ſound is much more diſtinct when the tremor is communicated to the teeth of the upper jaw, though they are the nerves of the under one that are chiefly connected, a branch of the fifth pair being connected to the ſeventh; and that obſervation may be applied to practice, with conſiderable relief. Thus, if we want to converſe with a perſon dull of hearing, a thin piece of very hard wood may be taken that can have a tremor

eaſily communicated to it, one end is applied to his fore teeth of the upper jaw, and the other end of it is put into your mouth, and by ſpeaking, he will apprehend what you are ſaying, though he is not able to hear a ſingle letter, if the bit of wood be removed; ſo it is communicated through the bones which impreſs the nerves of the ear, as they receive the impreſſion from the tremor applied in the other two ways.

CCXCVI.

By receiving an impreſſion in different ways, perhaps we judge better of a ſound than if the tremor is communicated in one way only.

CCXCVII.

The uſe of the Euſtachian tube ſeems confined to one purpoſe chiefly, to ſupply the cavity of the tympanum with elaſtic air, properly warmed before it reaches the very tender parts of the internal air. Another purpoſe of it is perhaps to convey moiſture, or ſordes, collected by the ſecretion within the cavity of the tympanum; and this may be more neceſſary here where the air is admitted; for, as the ſubſtances floating in the atmoſphere are conveyed into it, theſe ſhould again have a proper outlet.

CCXCVIII.

It remains to determine the way in which the impreſſion is conveyed from the membrane of the

oval and round holes to the portio mollis of the auditory nerves; for, after bringing the nerves to receive the tremor, we can give no further account why we judge fo accurately of found, any more than we can explain the effect that the objects of fight have upon the retina; and the queftion that occurs here is this? Whether are we to fay that the tremor is communicated through air filling the cavities of the veftible and femicircular canals, or are thefe replete with water? Upon the whole, it would appear that the tremor is communicated to water, and through the water to the nerves.

CCXCIX.

In regard to the great fize of the femicircular canals and cochlea, they are proportionally larger in a child than the correfponding bones; the reafon of which is, that a very confiderable hardnefs of bone, capable of tremor, is here neceffary; and thefe hard bones do not grow in the fame porportion with the reft of the body: as with regard to the teeth, nature does not fo readily increafe the hard parts fo quickly as the foft, and there being no room for making a change here, as in the teeth, thefe parts are caft in a larger mould.

CCC.

In examining the circulation of the ear, we find that the arteries of the external ear come anteriorly from the temporal, and pofteriorly from the

occipital, both being branches derived from the external carotid; and its veins paſs partly into the external, and partly into the internal jugulars. The origin of the poſterior auris is from the ſituation of the parotid. It paſſes under the ſtyloid proceſs, and goes up directly behind the ear; and after giving branches in its progreſs, it diſtributes one twig, termed arteria tympani, to the loweſt part of the cartilage, which ſpreads itſelf on the drum of the ear, and in the child it is particularly large. Its next branch, of conſiderable ſize, enters the maſtoid hole as the great nerve of the face comes out, and this artery divides upon the tympanum by a branch ſurrounding the bony circle, and then ſpreading over the membrane, another twig ſupplies the muſcle of the ſtapes and the ſemicircular canals. Branches alſo play round the back part of the concha, or ſhell of the ear.

CCCI.

The nerves of the ear are numerous from various ſources. The forepart of the ear is ſupplied with nerves from the 3*d* branch of the 5*th* and the portio dura of the 7*th* pair: the under and back part, by branches from the 1*ſt* and 2*d* cervicals. But the chief nerve of the ear is the auditory one. It is compoſed of two branches, one of which is called the portio dura, and the other the portio mollis. The trunk of this nerve paſſes into the external meatus, covered by the

investing membrane of the brain. The portio dura distributes its branches on the stapedius muscle and mastoid cells. The portio mollis divides into two parts, one supplying the cochlea, the other the vestible. Thus the portio mollis forms the primary part of the organ of hearing, to which all the others are subservient, and is the same expansion to the ear that the retina is to the eye.

CCCII.

Chemical Analysis of the Secretion of the Ear.

The secretion of the ear is in small quantity in health, and it assumes at times a solid cylindrical form from the attraction of oxygen from the atmosphere. It is of a yellowish colour, of an unctuous or waxy consistence, and bitter to the taste, without becoming rancid while retained in the ear.

Its constituent principles appear to be;

1. Animal mucus.
2. A ceraceous part, or oil, inspissated by oxygen.
3. A bilious principle secreted from the blood.

The Eustachian tube secretes a mucus which passes into the fauces, but differs in nothing from mucus elsewhere, consisting merely of inspissated lymph.

The cavity of the tympanum is filled with an insipid water, which has no taste or smell, but becomes white, and is inspissated by the sulphuric acid.

CCCIII.

Descending from the parts last demonstrated, we come to examine the throat. It consists of three divisions, the arches of the palate, the pha-

rynx, and larynx, and each of them were already partially confidered, from their connection with the mufcles.

CCCIV.

Arches of the Palate.

The arches of the palate are formed by a doubling of the fkin, joined by fome mufcular fibres arifing anteriorly from the middle of the velum, and fixed to the fide of the edge of the tongue; and pofteriorly from the fame origin, but paffing down by the fide of the pharynx.

CCCV.

The anterior arch compofes, with the mufcles defcribed (Vol. I. CCCXXVI.), the ifthmus faucium. The pofterior inclofes the levator mufcle; and between the two arches, clofe by the bone of the tongue, is fituated the amygdalæ, of an almond figure, reddifh colour, full of communicating cells, and with large irregular openings for the difcharge of mucus into the throat, the quantity of which is promoted by the action of the adjacent parts.

CCCVI.

Pharynx.

The pharynx was difcuffed in (Vol. I. CCCXXVII.) Its circulation is conducted by the pharyngeal branches, which come directly or indirectly from the external carotids, and its blood is returned to both the jugular veins. Its nerves are derived from the 8*th* pair.

CCCVII.

Larynx.

The larynx, the laſt diviſion, was alſo demonſtrated at length, (Vol. I. CCXCIX.) with its ſeveral appendages. The circulation of this part depends alſo on the external carotids in part, for they give off to it the two ſuperior laryngeals: but it has another, likewiſe, from the ſubclavian artery, or the two inferior laryngeals; and its blood is all returned to the external jugulars. Its nerves are prolongations of the 8*th* pair.

CCCVIII.

Trachea.

The continuation of the larynx, or the trachea, forms the paſſage to the lungs. It is of a ſomewhat conical figure, at firſt cylindrical, capable of admitting a finger in ſize, and narrower at its under end. It paſſes into the thorax behind the ſternum, between the pleura; and, at the fourth vertebra of the back, or curvature of the aorta, it divides into two branches, termed bronchia, one to the right and another to the left, which enters the lungs, the right ſide being ſhorter than the left, in oppoſition to what takes place in reſpect to the pulmonary arteries.

CCCIX.

Bronchi.

The bronchi are ſpread on the lungs, and minutely dividing, at laſt terminate in the cells which

have a free communication with each other, ſo that the introduction of air into the bronchial branches inflates a portion of the lungs.

CCCX.

The trachea is formed, for the purpoſes of firmneſs and ſtrength, of from 16 to 18 cartilaginous rings; and by this ſtructure it is preſerved conſtantly pervious for the tranſmiſſion of air. Behind theſe rings are incomplete, and the trachea is even fleſhy, in order to yield to the action of the œſophagus in the time of deglutition. Theſe cartilages are placed horizontally to each other; they form a large ſegment of a circle, and they are united to each other by a firm ligamentous ſubſtance; though, in their upper part, little or no ſpace intervenes between them.

CCCXI.

The diviſion of the bronchi is diſtinguiſhed at firſt by the ſame ſtructure, but, as they enter the lungs, the circle of the cartilage is broken into pieces, and only ſo much is preſerved of it as to keep the paſſage open and free.

CCCXII.

This ſtructure of the trachea is defended by ſeveral coverings, both to ſtrengthen and give it motion. The firſt of theſe is a cellular matter, covered on its entering the thorax by the mediaſtinum. The ſecond is an elaſtic ligament, paſſing

along it, and adding to the elaſticity and firmneſs of its branches. The third is a muſcular coat, chiefly conſpicuous between the rings and at the back of the trachea, and poſſeſſing, externally, circular fibres for ſtraitening the paſſage, and internally, longitudinal ones for ſhortening it. Theſe longitudinal fibres are the moſt extenſive, and paſs far into its branches in the lungs.

CCCXIII.

The internal ſurface of the trachea is lined with a vaſcular irritable membrane, every where poſſeſſing a mucous and lymphatic ſecretion. The exiſtence, therefore, of mucous glands and exhalant veſſels, is every where to be traced on this ſurface. But, beſides this, for the ſame purpoſe of defence from irritation, ſome farther glandular appendages are connected with this part. Theſe are the thyroid gland, the tracheal glands, and the bronchial.

CCCXIV.

Thyroid Gland.

The thyroid gland, ſo termed from the cartilage formerly deſcribed, is a large reddiſh maſs behind the ſterno-hyoid and ſterno-thyroid muſcles, at the under and fore part of the larynx. It deſcends a certain way upon the trachea and æſophagus, and it poſſeſſes two lobes joined by an intermediate portion. From the viſcid liquor it ſeems to ſecrete, and its internal granulous

appearance, its office we would infer to be, to lubricate the adjacent parts. For this purpofe it is fupplied with large blood veffels and nerves from thofe of the larynx, but ftill no excretory duct has been difcovered in it to render its ufe certain.

CCCXV.

Tracheal Glands.

The tracheal are a numerous fet of mucous glands, fituated in the mufcular coat of this membrane, and extending alfo into the lungs. Their office is evident, from each poffeffing an excretory duct that throws out a mucus on the furface of the membrane.

CCCXVI.

Bronchial Glands.

The bronchial glands occupy the cellular fubftance at the under part of the trachea and roots of the bronchi. They are of various fizes, of a bluifh or dark colour, refembling fome parts of the lungs, and they are evidently, when examined, of a lymphatic nature.

CCCXVII.

The circulation of the trachea is fupplied by the inferior laryngeals, and its nerves are portions of the recurrent and great fympathetic pair. The lungs poffefs, as it were, a double circulation, the one by the pulmonary veffels, and the other by the bronchial.

CCCXVIII.

The uſe of the pulmonary circulation was already explained in conſidering that of the heart. This circulation is carried on by the pulmonary artery dividing into two branches of right and left, which are diſperſed through the ſubſtance of the lungs, and form by their minute branches plexus, giving out the halitus expelled by the organ in expiration. The pulmonary veins join in four principal trunks, which collect the blood, and return it to the left auricle of the heart; and the veins through the whole ſubſtance of the organ bear an inferior proportion to the ſize of the arteries.

CCCXIX.

The bronchial circulation again, or that peculiar to the lungs, is conducted by means of three or four ſmall branches, which, except one ariſing from the right ſuperior intercoſtal, are all from the aorta. They are minutely diſperſed on the bronchi, in the glands and lungs, and they are found to communicate with the pulmonary artery, ſo that the nouriſhment of the organ cannot be their ſole uſe. Their blood they return to the vena azygos and left ſuperior intercoſtal vein.

CCCXX.

The nerves of the lungs are ſmall in proportion to the ſize of the organ. They are chiefly derived

from the 8*th* pair, and alſo in part from the great ſympathetic.

CCCXXI.

From this view, a large apparatus is provided for the ſecretion of lymph and mucus to lubricate and moiſten the ſurface of the paſſages to this organ. Hence it would appear neceſſary that this large ſupply ſhould be afforded to guard againſt the action of the gazeous fluids, which are conſtantly extricated by expiration, and which thus unfolded, might act two powerfully on the paſſages through which they are expelled, producing inflammation and other conſequences.

CCCXXII.

In a former part, we conſidered in a general way the ſtructure of the lungs, but it is only when fully examining that of the trachea, or the paſſage into them, that their minute parts come properly into review; the principal and moſt important of theſe minute parts, as the ground work of their ſtructure, is the air veſſels. The trachea is compoſed of membranes, with muſcular fibres and rings of cartilage, which are imperfect behind. This allows the food to deſcend in the æſophagus; and the circle not being complete, the trachea in the reſpiration and formation of the voice, alters its length and diſtenſion more readily.

CCCXXIII.

When we follow the trachea to its diviſion

into branches, a ſimilar ſtructure takes place a great way through the ſubſtance of the lungs; but as now there is no reaſon why the defect ſhould be only in the poſterior part, the ſegment makes perfect portions of a circle in the whole circumference, 'till the tubes become membranous; and theſe terminate in cells of a ſimilar ſtructure, ſo far as we may judge by the eye.

CCCXXIV.

Theſe ultimate branches of the trachea can be ſeen with the naked eye. The minute cells are found to communicate freely with one another, ſo that if we blow air into the ſmall branches, a much greater portion of the lungs is inflated, and from a ſingle lobule we can fill the whole lobe; ſo every cell of the lungs has not its correſponding branch, but they are more numerous, and the cells are ſo extremely minute, that upon entering into a calculation we are ſurpriſed with the vaſt extent of ſurface; and the pulmonary artery has a very minute diviſion, every where giving redreſs to the ſides of the cells.

CCCXXV.

The air within the cells is confined by a membrane proper to the lungs, and this membrane is more extenſive than merely from viewing the lungs we would conceive; for the diviſion into lobules goes to a great depth, and theſe diviſions

of the lungs into lobules, allow them to accommodate themſelves to the ſize of the thorax, every part to be expanded in the moſt equable manner. That their play upon each other may be the eaſier, and they may the more readily retract, a cellular membrane enters between the lobules; and the whole is covered over with the pleura, without any communication. It has been ſuppoſed that the cells communicate with the common cellular membrane, the conſequence of which muſt be the diffuſion of the air in the interlobular cellular membrane, and from that over the whole body; hence we ſhould be expoſed to emphyſema and to anaſarca in the lungs, the water making its way into their cavity. When the lungs are taken out ſound, we can indeed, upon blowing in air, make it go into the interlobular cellular membrane, and we are apt to imagine that when we do this with the force of our breath, the ſame violence is done to our own lungs; but our lungs are prevented from over diſtenſion by the containing parts of the thorax, ſo that we can burſt lungs that in life were ſtronger than our own; and before opening the thorax, we are often not able to make injections paſs into the cellular membrane. Thus we may compare this membrane proper to the lungs, to the pia mater of the brain, whilſt the pleura is repreſented by the tunica arachnoides. It chiefly allows the lungs to play

upon the ribs without being injured, ſo the ribs are lined with the continuation of the ſame membrane.

CCCXXVI.

Practical authors treat the cells of the lungs as poſſeſſed of a truly contractile power, and they ſuppoſe that the appearance of ſuffocation depends upon the contraction of the cells of the lungs. That the veſſels entering into the compoſition of the lungs may be ſpaſmodically affected, is to be admitted; but there is no reaſon to ſuppoſe that the cellular texture is truly muſcular in its appearance; and in different animals, when the lungs are irritated with a very acrid liquor, no immediately ſubſequent contractions enſue; and in the aſthma the ſuffocation depends very much upon the affection of the glottis, the various affections of which are more frequently aſcribed to the lungs than they ought; alſo whilſt we admit the affection of the veſſels of the lungs, we muſt regard the change produced on the glottis, which can be conſtricted on the moſt accurate manner.

CCCXXVII.

With regard to the circulation of the blood in the lungs, the ſame quantity of blood paſſes through the lungs in the ſame time as through the reſt of the body; and the quantity and velocity are nearly the ſame in the pulmonary artery as in the aorta. The force, however, is very dif-

ferent from the difference of thickneſs in the two ventricles. In the aorta, the force is three times greater than in the pulmonary artery; but when we conſider the diviſions made by the pulmonary artery in the lungs, they are by no means ſo extenſive as the diviſions made by the aorta, and, therefore, though the force of the blood is greater in the trunk of the aorta than in the trunk of the pulmonary artery, the force in the extreme branches of the pulmonary artery is greater than the force in the extreme branches of the aorta; and on that circumſtance depends an obſervation, that a wound in the lungs bleeds more violently than a wound of moſt of the bowels belonging to the aortic ſyſtem. Comparing the force of the two ventricles, the thickneſs of the left ventricle is three times that of the right; but the number of veſſels of the aorta is fifteen times greater, for the lungs do not make above the thirtieth part of the weight of the body. Now, making an allowance for the earth of the bones, the fat and extravaſated liquors, and allowing that the lungs are more purely vaſcular, the blood is ſtill ſpent upon a field that weighs fifteen times as much; and, where the veſſels are numerous in proportion to the weight, the number in equal portions is greater; for, upon injecting fluids, they paſs more readily from the pulmonary artery into the vein than in other places of the body.

CCCXXVIII.

It is generally ſuppoſed that the veins are not in ſuch proportion to the arteries in the lungs as elſewhere, but there is no ſuch difference as is generally ſuppoſed. In the aortic ſyſtem many veins run under the muſcles, and hence there are two ſets, and the cava is larger in proportion than the pulmonary veins. There is, likewiſe, an inequality in the ſize of the two ſides of the heart; the right one is originally larger than the left, and, perhaps, the difference increaſes with uſe or years, becauſe of the unequal ſtop in reſpiration, the blood paſſing with more difficulty through the lungs in the ſtate of expiration than in inſpiration when the veſſels are drawn more out into ſtraight lines, and the preſſure of the air within the lungs is taken off, for the air does not not ſo readily enter by the narrow paſſage of the glottis as to make the ſame preſſure in inſpiration as takes place in expiration. When the ſides of the thorax are drawn in, from the paſſage of the air being difficult through the glottis, the pulmonary veſſels come to be compreſſed.

CCCXXIX.

There is a minute diviſion of the blood veſſels upon the cells of the lungs, which appear every where red upon the veſſels being injected, but there is no appearance, except of glands, for mucus, and yet a ſeparation is made from the

extremities of the pulmonary veſſels of a matter that is pernicious to animals, as already explained.

CCCXXX.

Beſides the pulmonary veſſels, there are other ſmall but conſtant arteries derived from the aorta, the bronchial ones, the number varying in different ſubjects, and they make a very intimate diviſion through the ſubſtance of the lungs. At firſt we might imagine that they are accidental *luſus naturæ*, from the aorta ſcattering itſelf on all ſides, but we cannot doubt that material purpoſes are ſerved by theſe veſſels, though it is difficult to ſay what theſe may be. In like manner, the coronary arteries of the heart are derived from the aorta only; and, tracing theſe back, the veins terminate on the right ſide, though we ſhould have imagined that they would have more readily gone into the left auricle with the pulmonary ones: and, in the liver, though we find a great quantity of blood furniſhed by veins, and forming the vena porta, we ſhall find a branch conſtantly from the aorta: ſo that it would appear that there are purpoſes neceſſary to be done in the various organs, which the whole maſs of blood, or veſſels carrying it through theſe organs, are not fitted to execute, or that a greater change is produced by a *ſingle* circulation than at firſt ſight we are aware of.

CCCXXXI.

It is generally ſuppoſed that the bronchial veſſels ſerve for the nouriſhment of the lungs; but, though the nutrition depends upon the blood veſſels, it cannot be with certainty affirmed that this is the purpoſe they ſerve, nor ſtill leſs that it is the ſole purpoſe. It can only be ſaid that, by a ſingle circulation a conſiderable change is made; and that, by a paſſage of the blood through the lungs, a ſomething wanting is reſtored to it, and yet we ſhall find that all that is received by the abſorbent veſſels of the lungs, paſſes into the right ſide of the heart, and is furniſhed to the pulmonary artery.

CCCXXXII.

Following the bronchial arteries with care, they communicate with the pulmonary ones, and theſe anaſtomoſes are ſometimes found of conſiderable ſize.

CCCXXXIII.

A number of minute glands are obſerved on the back of the trachea, that make circles in the rings of the trachea, and which evidently pour out mucus. Theſe glands can be traced in the larger branches of the trachea, and what is ſeen there may be applied to the moſt minute branches, as they muſt have a very extenſive diſtribution here as in other places, wherever the air has acceſs, or acrid liquors are applied, which require the ſeparation of a mucous or ſebaceous matter.

CCCXXXIV.

There is another ſet of glands, the uſe of which it may be more difficult to determine, the glands named bronchial. Some authors are diſpoſed to arrange theſe with the lymphatic glands; but, when ſpeaking of the ſecretions in the trachea arteria, they are mentioned as performing a ſecretion. At firſt ſight, there is a degree of improbability in the opinion, and they were led into it from this circumſtance, that theſe glands from the diviſion of the trachea are of a dark colour, and we throw out from the trachea dark blue coloured matter after twenty years of age; hence it is inferred that there muſt be a communication between the bronchial glands and the cavity of the trachea. But the whole matter is to be explained very differently: all the matter abſorbed from the lungs paſſes to the right ſide of the heart; ſo the changes made upon the blood in this leſſer circulation, do not depend upon a difference of mixture or parts.

CCCXXXV.

With regard to the colour of the matter in the bronchial glands, in a young ſubject nothing is obſerved of the black matter. In an adult, the colour of the lungs gradually changes from a brown to a black colour, and the ſame veſſels which, by ſeparating a certain ſubſtance, give

that black colour to the ſolid part of the lungs, by making a ſimilar ſecretion into the cavity of the trachea, may give the ſame colour to the mucus. Thus the extremities of the pulmonary artery diſcharge, by the exhalant terminations, the black colour; and the bronchial glands giving paſſage to the abſorbent veſſels, receive the black tinge from the lungs. The trachea receives the colour firſt, and communicates it to the bronchial glands; and, as all the ſolid parts of our body are conſtantly undergoing a change, the ſolid maſs of the lungs themſelves will be in courſe gradually re-aſſumed by theſe abſorbent veſſels, ſo the colour will alſo be communicated in that way, and the colour of the lungs of theſe glands always correſponds. From this, the bronchial glands ſerve a ſingle purpoſe, that of abſorption, and receive their colour from the lungs.

CCCXXXVI.

Having fully traced the circulation of the carotid, or firſt ſuperior aortic branch, through the different organs it pervades, we next purſue the courſe of the ſecond, or the ſubclavian. It conſiſts of two branches, the left ſubclavian, and the right one. The former emerges from the aorta at its turn towards the ſpine, paſſing out of the cheſt obliquely, and receiving its circulation in an unfavorable direction. The right ſubclavian takes its origin from a common branch between it and

the carotid, riſing on the top of the aortic arch, and receiving the blood in a direct current.

CCCXXXVII.

As the ſubclavians paſs along in their progreſs, their name becomes changed. Within the breaſt they preſerve their appellation, in the arm pit they are termed axillary, down the arm brachial, when dividing at the bend of the elbow, radial and ulnar, and in the head they are loſt in a variety of vaſcular diviſions.

CCCXXXVIII.

In its firſt diviſion, or real ſubclavian courſe, it is protected by the bone of that name. It is here of great ſize, and runs directly acroſs at the root of the neck, and it ſends off a variety of branches both upwards and downwards.

CCCXXXIX.

The firſt of its branches paſſing downwards is the internal mammary; and, as this artery ſupplies the circulation of the breaſt, the ſtructure of that organ becomes properly premiſed; and being an organ of more importance in the female than in the male, the female breaſt is preferred for examination.

CCCXL.

Breaſts.

The female breaſts are two glandular bodies, ſituated on the anterior part of the thorax ſome-

what laterally, and loosely adhering to the pectoral muscle: a situation which only distinguishes the human female and the ape, for in quadrupeds they are placed under the abdomen.

CCCXLI.

Though two are almost universally the number appropriated to women, in some rare instances a variety has been met with, as two on one of the sides, and even two on both sides.

CCCXLII.

The size of the breasts is very different in different females, and in no organ of the body is a difference of size so conspicuous. Previous to puberty they are always small; but they evolve, and become prominent as the menses take place. Their size is gradually increased by gestation, and comes to its ultimate magnitude after delivery. As child bearing departs from the age of 45 to 50, when the menses disappear, their size diminishes; and they gradually, in the advance of life, turn wrinkled and flaccid.

CCCXLIII.

The chief magnitude of the breast, in its ordinary state, is formed by a quantity of fat, which defends the glandular part; but does not, as it is alleged, pass into or communicate with the lactiferous tubes, or has a connection with the formation of the milk.

CCCXLIV.

The glandular, or ſecretive part of the breaſt, is of the conglomerate kind, of a whitiſh firm texture, and irregular in its ſubſtance. It is compoſed of a number of ſmall follicular maſſes ſeparated by fat, and theſe undergo moſt minute ſubdiviſions.

CCCXLV.

Nipple, or Papilla.

In the centre of the breaſt is the nipple or papilla, red in its colour, and cylindrical in its form, of various ſizes in different females, and increaſed by the ſame circumſtances which increaſe the ſize of the breaſt, being particularly liable to be diſtended by titillation and paſſions of mind. It is formed of tough ligamentous ſubſtance, or a condenſed cellular ſtructure, which incloſes the lactiferous tubes, is eaſily drawn out or diſtended, and from its elaſticity collapſes readily again when the diſtending cauſe is removed. Upon its point, or apex, are placed the lactiferous orifices, which correſpond in number to that of the tubes, being from 14 to 20.

CCCXLVI.

Around the nipple is a conſpicuous circle or diſk, named the areola, varying in colour from the reſt of the ſkin, and deriving this appearance from a number of ſebaceous glands which pour out a quantity of ſebaceous matter to prevent the

ſkin from being excoriated. The colour of this diſk varies at different periods of life, and under various circumſtances. Thus it is florid in girls, pale brown in women more advanced, and it becomes livid and dull with age. Thus, alſo, it becomes darker in pregnancy than at any other time.

CCCXLVII.

The circulation, then, of this organ is ſupplied by the mammary arteries, external and internal. The former are ſent off from the ſubclavian, as already noticed, the latter from the ſame artery in its further progreſs, when it receives the appellation of axillary, and the different diviſions of theſe arteries enter the breaſt at different places. Theſe are alſo accompanied by correſponding veins which receive the ſame name.

CCCXLVIII.

From the extremities of the arterial circulation of the breaſt, ariſe the lactiferous tubes, which are extremely numerous, and gradually unite into trunks, running in a radiated manner round the circle of the nipple. They form the reſervoir of the milk, and are accordingly conſiderably increaſed in ſize in the time of ſuckling.

CCCXLIX.

At the root of the nipple the number of lactiferous tubes becomes contracted from 14 to 20, but their number varies much in different ſubjects,

and they have therefore been variously represented by different authors.

CCCL.

They have been also supposed to possess a circle of communication, but this is disproved by the course of injections. The situation of the tubes in the nipple is peculiar for the purpose of preventing a spontaneous flow of the milk.

CCCLI.

This peculiarity consists in their distance from each other, and in the coiled up form in which they are placed. Thus, when drawn out and extended, they become straight, but easily recover their former situation on the extension being removed, or they become narrower and crooked.

CCCLII.

Though the secretion of the breasts is the effect of conception, yet a fluid is frequently formed in them in other situations. Thus, at birth, the cutaneous tubercle of the infant's breast contains often a milky liquor, and continued sucking has often brought to the breasts of girls and old women an appearance of milk, nor has this fluid been wanting in men on the application of the same means.

CCCLIII.

Sucking is an operation which, in some respects, resembles the principles of the air pump.

But the child does not merely apply the lips round the nipple, and then make a void in the mouth, but it aſſiſts the elongation of the nipple, and ſtimulates it ſo as to cauſe the filling of the cells, or the child takes hold of it with the tongue, and drags it mechanically into the mouth, uſing the tongue like the ſucker of a ſyringe, and the membrane of the lips of the child is ſwelled and raiſed for excluding the air, which has been miſtaken for a diſeaſed ſtate of theſe parts, and the tongue being drawn back for making a void, the preſſure of the air upon the breaſt puſhes the milk where there is the leaſt reſiſtance. But, by an inſtinct of nature, the child adds ſomewhat, for it applies the hand to the nurſe's breaſt, and even, at the ſame time, uſes the feet to preſs againſt the ſide, that they may act with greater force.

CCCLIV.

Chemical Analyſis of the Secretion of the Breaſts.

The ſecretion of the breaſts, or milk, is a fluid, white, opaque, inodorous, and ſweet. It is of an oily and aqueous conſiſtence, a drop falling on the nail ſhould flow ſlowly down.

This ſecretion begins in the laſt months of pregnancy, and appears on the ſecond or third day after delivery by a fullneſs and diſtenſion of the organ. It is firſt ſeparated of a ſomewhat ſerous nature, termed the coluſtrum, but ſoon acquires its proper quality.

This ſecretion continues ſo long as the child con-

tinues to fuck, even for years, and is only interrupted by a frefh pregnancy.

The quantity fecreted in a given time, is various in different women, and depends much on the quantity of nourifhment and other circumftances, but not more than 2 lbs. of milk have been confidered as arifing from 5 or 6 lbs. of meat.

This fecretion is found naturally to feparate into three parts, an oily, coagulable, and watery part, and this feparation takes place fooner in an increafed temperature than otherwife; and it is alfo promoted by falts and particular coagulable plants.

The conftituent principles of the milk are;

1. An aroma, or odorous principle, which flies off when frefh drawn.

2. Water, which conftitutes its greater part; for, from 1 lb. 11 oz. of water are procured.

3. Oil, or cream, which fwims on its furface after ftanding.

4. Cheefe, or coagulum, which feparates from the other parts, and falls to the bottom.

5. Sugar, procured by evaporation of the ferum.

6. Various neutral falts, as tartrite of potafh, phofphate of lime, &c.

Thefe conftituent principles, thus united, we next examine, as they exift in its particular parts.

Thus, its cream, which refembles the vegetable fixed oils, confifts of carbon, hydrogen, and febacic acid.

Its cheefe, or coagulum, which is of the fame nature as the animal gluten, is formed of carbon, azote, and phofphate of lime.

Its ſerum is a compoſition of its water, aroma, and ſugar, with the neutral ſalts formerly noticed. Hence this part forms the medium, uniting by means of its ſugar the cheeſy and oily part with the purely aqueous.

The ſugar itſelf is the baſis of the ſaccho lactic acid, and forms alſo the acid of ſugar; both which are procurable by a particular treatment.

The milk, like the other ſecretions, is much varied in its nature from a variety of circumſtances; as,

1. From particular food. Thus a vegeto-animal diet unites its parts more completely than any other, and it is not ſo liable to aſcency as from vegetable diet alone.

2. From time of digeſtion. For the milk is beſt at a due period, or 4 or 5 hours after eating, when digeſtion is completed.

3. From period after delivery. For it is at firſt too ſerous, and gradually acquires more of the coagulable principle as the period of ſuckling advances. Hence old milk is improper for a young child.

4. From peculiar ſubſtances or medicines. Thus milk becomes impregnated with the odor of garlic, and medicines given to the nurſe, by their change on the milk affect the child.

5. From paſſions of mind. Thus affections of the nervous ſyſtem produce often ſuch an alteration in the ſecretion, as moſt ſenſibly to affect the health of the child.

Anatomical Preparation of the Breaſt.

To prepare the breaſt requires much time and patience. A milk breaſt ſhould be preferred; and the

firſt ſtep is to remove it carefully from the body without wounding any of its parts. The nipple being next examined, a briſtle is to be inſerted into each of the excretory ducts, and into one of them the pipe is to be afterwards introduced, ſo as to diſtend them with quickſilver. When completely filled, the orifice is to be ſecured by replacing the briſtle, and in this way each tube is to be filled by withdrawing the briſtle; and after injecting it again, replacing it. When finiſhed, the orifices of all the ducts are to be ſecured by a ligature, embracing the whole nipple when the briſtles are entirely withdrawn. If any tube has given way, or been wounded, it muſt be next ſecured, and then all the fat and other extraneous ſubſtance is to be carefully diſſected away; after which, the part is to be macerated to free it as much as poſſible from blood; guarding againſt putrefaction; after which, it is to be expoſed to a current of air to dry as ſoon as poſſible. When dried, it is next to be preſerved in fine oil of turpentine, which will render it tranſparent, and diſplay the diſtribution of the lactiferous tubes.

CCCLV.

The internal mammary artery ſent off, as formerly noticed, from the ſubclavian, is about the ſize of a crow quill. On each ſide of the cheſt it paſſes down along the inner ſurface of the ſternum, and terminates at the enſiform cartilage by numerous inoſculations with the epigaſtric artery; and this connection of the two arteries is intended merely to guard againſt obſtructions. Yet more

material consequences have been supposed to attend this communication, for it has been supposed that the flow of milk, after delivery, depends upon it. Immediately after delivery there is a great discharge from the uterus; and in consequence of the mouths of its vessels being so freely opened, the push is lessened into all the other vessels, so it is several days before the milk appears. But as soon as, by the contraction of the uterus and the blood coagulating in the mouths of the vessels, a small quantity is circulated through the body of the uterus, there is an increase of the momentum of the blood in the epigastric artery to the mammary one, which is supposed to occasion the flow of milk.

CCCLVI.

But this is absolutely inconsistent with anatomical facts, and the theory cannot be reconciled with the general laws of the circulation of the blood; for if the flow of the milk depended upon the particular course of the epigastric artery, and the force of the circulation was increased in this, instead of finding that it only communicates by small branches with the internal mammary artery, we should have found it to terminate immediately upon the mamma: it is inconsistent with the laws of the circulation to suppose it. For are we to imagine that the blood runs from the smallest branches of the artery into its trunk?

This never happens, unlefs when the mammary artery is taken up with a ligature. And this is one ufe of the joining, that in cafe of an obftruction of the mammary artery, there may be a fupply. But, in the ordinary courfe of the circulation, it is abfurd to fuppofe that any blood enters the breaft this way. The only effect is, admitting that lefs paffes through the uterus, and that more enters the epigaftric artery, the blood will not pafs downwards by the fmall branches of the mammary artery, as before. But it is to be doubted, if the communication can have fuch an effect, for, before delivery, the uterus preffing ftrongly upon the defcending aorta, and upon the containing parts of the abdomen, would make a greater refiftance to the defcent of the blood by the branches of the mammary artery than the increafed momentum of the blood in the epigaftric can do, fo that the force of the circulation in the internal mammary artery is the fame before delivery as after. This matter may be even brought to the decifion of an experiment; for, if we were to cut through the rectus mufcle, and divide all the communicating branches, we would ftill find the flow to the breaft take place in the ufual manner.

CCCLVII.

We muft have recourfe, therefore, to an explanation that depends upon very different prin-

ciples. Whatever idea we entertain of the cauſe of the menſtrual flux, whether it depends upon a general or partial plethora, at delivery the conſtitution has been in the habit of preparing blood both for the mother and child; and that habit continues to remain for a certain length of time. For the firſt days, indeed, after delivery, there is a general debility from the openneſs of the veſſels of the uterus, and the great diſcharge of blood; but when it is ſtopped by the blood coagulating in their orifices, and by the uterus greatly contracted, as the veſſels of the body have accommodated themſelves to the quantity of liquors they contain, and as every woman with child has the veſſels immediately diſtended, there is ſtill remaining a conſiderable degree of fulneſs; ſo that unleſs ſome outlet is given by the breaſt, by ſucking, nature ſeeks an outlet ſome other way; the woman ſweats very profuſely, or is in danger of falling into ſome diſeaſe, as a fever. Hence there is the neceſſity of the ſeparation of the milk.

CCCLVIII.

Beſides, nature nouriſhes the child, before delivery and after it, nearly in the ſame manner, and by liquors nearly of the ſame nature; but there is a ſecretion in the uterus reſembling that made in the breaſt. And wherever the nouriſhing veſſels are collected into glandular maſſes, as in cows and ſheep, we find in theſe a liquor in

colour and tafte refembling the milk. In the human body the veffels are not fo collected; but by their divifion upon the ovum a fimilar fecretion is made. And when that fecretion comes to be interrupted, and the veffels recover their tone, then the flow is towards the breafts, juft as when the perfpiration is ftopped there is a flow towards the kidneys, the organ that refembles that the neareft. And if the child is applied, by the fucking the flow is better determined, and that independent of other caufes: this in animals that formerly had young will even bring again the milk. We conclude, therefore, that as the veffels of the mother had been in the habit of preparing more nourifhment than was neceffary for herfelf during the nine months of pregnancy, that this conftitution for a certain time remains; and as the fecretion made in the uterus refembles that made in the mammæ, when there is an interruption of the one fecretion, there is an increafed fecretion in the other glandular organ.

CCCLIX.

While the internal mammary artery inofculates, as we have feen, with the epigaftric, the external one does the fame with the lumbar arteries. In its progrefs, as it paffes down along the cheft, it gives off feveral branches. One of the chief of thefe is the upper artery of the diaphragm, and its lower artery is the firft branch of the aorta within the abdomen. The mammary branch ac-

companies the phrenic nerve in its courſe, and is ſpread out along with it on the diaphragm. In its progreſs it diſtributes ſmall twigs to almoſt all the parts within the cheſt. Beſides this, the mammary artery gives two branches to the pericardium, the one the upper, and the other the phrenico pericardiac artery. It diſtributes likewiſe many ſmall branches to the mediaſtinum, and ſends others to the interſtices of the ribs.

CCCLX.

A ſecond diviſion of the ſubclavian is the thyroid artery, which buds out from its root, where it is named the great axillary, in the form of a ſhort thick ſtump, and divides into four ſlender branches, which are diſtributed to the thyroid gland, trachea, and adjacent parts.

CCCLXI.

The vertebral artery makes its third great diviſion, which plunges into the vertebral hole, and contributes to the circulation of the head in the manner already noticed. It is ſucceeded by two other branches, the deep and ſuperficial cervicals, which are ſpent moſtly on the neck.

CCCLXII.

Thus, in enumerating the diviſions of the ſubclavian, the origin and progreſs of the mammary and diaphragmatic arteries are clear and diſtinct. The vertebral artery goes to the brain, and the cervical ones to the muſcles of the neck, while the thyroid arteries ſupply the ſame place as well as the gland.

CCCLXIII.

After theſe branches follow the ſuperior inter-coſtal, which ſupplies the two firſt ribs, being about the ſize of a crow quill. In its courſe it runs downwards and backwards, and lodges itſelf in the hollow where the ſpine and firſt rib are joined. It gives off a number of ſmall branches, one part of which riſes to the neck, and another is ſent downwards. The ſupra ſcapulary is mentioned by ſome authors as an important branch, and often running off from the thyroid diviſion.

CCCLXIV.

As the ſubclavian artery enters the arm pit, it is termed axillary, and from this place its diſtribution to the ſuperior extremity proceeds. In the hollow of the axilla it lies ſafe, protected by the pectoral muſcle before, and the latiſſimus dorſi behind, and ſurrounded with fat and glands. From this part it gives off the thoracic arteries to the cheſt, and the ſcapulary arteries to the ſhoulder. Proceeding in its courſe, the axillary becomes ſoon changed to the brachial artery, and this diviſion is marked by the tendon of the great pectoral muſcle. This appellation it receives till it divides at the bend of the arm into the radial and ulnar branches. It runs cloſe along the os humeri on its inner ſide, where the bone is almoſt naked, and keeps exactly the interior ſurface of

the arm bone, giving off frequent branches in its courſe, three of which only deſerve notice, the two arteries named profunda, and the great anaſtomoſing branch.

CCCLXV.

But the brachial artery thus deſcribed does not immediately divide, even after it has paſt the bend of the arm, but deſcends deep into the fleſh of the forearm, and there its diviſion takes place into three great branches, the radial, ulnar, and interoſſeous arteries.

CCCLXVI.

The ulnar artery perforates the thickeſt fleſh of the forearm, pervades the ulnar edge of the arm, appears ſuperficial 3 or 4 inches above the wriſt, and goes down to the root of the little finger.

CCCLXVII.

The radial artery paſſes in the manner of a branch from the ulnar, running to one ſide. It is more ſuperficial on the forearm than the ulnar, and it turns backwards over the wriſt, or root of the thumb.

CCCLXVIII.

The interoſſeous is an ulnar branch: where this artery lies deepeſt, it runs along the interoſſeous, and ſcarcely paſſes the wriſt.

CCCLXIX.

Each of theſe arteries poſſeſſes a particular branch, termed recurrent, correſponding to the

anaſtomoſing arteries elſewhere; which, ſo ſoon as it has cleared the principal branch, returns backwards to ſupply the joint.

CCCLXX.

The radial artery at the wriſt turns round it over the head of the radius, and under the tendons of the thumb; and, before paſſing, it ſupplies the branch to the palm. When paſt, it ſends off the artery of the back of the hand. Branches are then ſent to the back of the thumb, and in its progreſs at the cleft betwixt the thumb and forefinger, it divides into three great branches, one to the inner ſide of the thumb, another to the forefinger, and the third into the palm of the hand; forming on the ſide of the palm, next the little finger, the celebrated inoſculation betwixt the upper and lower arches.

CCCLXXI.

The ulnar cavity, as it runs along the tendon of the flexor carpi, turns over the wriſt at the piſiform bone; from this it forms the ſuperficial arch of the palmar arteries, and ſupplies all the fingers, as the radial does the thumb. It ſends alſo a dorſal trunk round the back of the hand to the little finger.

CCCLXXII.

Such is the general diſtribution of the ſubclavian to the trunk and ſuperior extremity; and

in confidering the origin of the fubclavians from the aorta, the right one is more directly oppofed to the mouth of the ventricle of the heart coming off from the aorta, where it is about to make the turn, whereas the force of the blood is broken by the turn before the other branch of the left fide comes off. As mankind then, in general, prefer the right arm, there appears a connection with this fact, which may be received as caufe and effect. This circumftance is a very curious one. The more the matter is confidered, the more is it founded. For on comparing the nerves of both arms, they are of the fame fize, exactly connected in the fame manner. The only final caufe of the preference is perfectly evident, that by exercifing one arm more frequently, we acquire much more dexterity. But we muft find an efficient caufe, or fomewhat to determine us to ufe the one originally in preference to the other; for the great ufe proceeds not from reafon. Children give the fame preference, and we find it univerfal.

CCCLXXIII.

To this effect of the diftribution it may be added, that though motion does not primarily depend upon the blood veffels, it does fo in a fecondary degree. The nerves exert their energy more powerfully by the quantity of the blood difperfed along them, and we have feen many more veffels in the organ of

ſmell than we can well find uſe for. Now this trunk receives the blood with greater force and in greater quantity, and taking its riſe in a common trunk, the reſiſtance is much leſs, without at all alleging that the right ſubclavian is occaſionally conſtructed larger than the left; the blood runs through the common trunk with greater eaſe than through the ſecond and third branches, and there is leſs reſiſtance made by the ſides of the veſſels. And to compare this with the caſe of other animals, notwithſtanding the neceſſity they are under in walking to uſe the two anterior extremities exactly in the ſame manner, yet in them there is a preference: thus it is a very difficult matter to force a horſe to walk with his left ſhoulder foremoſt, he naturally prefers the right fore extremity.

CCCLXXIV.

In birds, this preference would have been hurtful, and would have brought them to the ground, juſt as the cutting the ſmalleſt bit of one of the wings, by the leſſening the ſurface, and thereby the force; whereas, when we cut an equal portion of both, the bird readily ſupports itſelf. In birds, then, the aorta ſends off two branches, and theſe are again equally ſubdivided. Hence there is great room to ſuppoſe, that this diſtribution of the arteries allowing the blood to enter more perfectly and free to the

right arm, and perhaps to return more readily from the arm, gives the preference; and that it is ſtronger, and therefore originally preferred.

CCCLXXV.

When we follow the ſubclavian a little further, we find ſmall branches ſent off to the thorax, upper part of the ſhoulder, and lower part of the neck; after which the artery paſſes under the clavicle, and hence it is named properly, ſubclavian, paſſing between the clavicle and right rib, and we can at this place readily diſtinguiſh the pulſation, ſo experiments may be made, which may be uſeful, in a variety of caſes, to ſtop the blood in the ſubclavian artery by a very ſlight preſſure. If the thumb is put upon it above the middle of the clavicle, and preſſed downwards againſt the firſt rib, the pulſe ceaſes immediately, which is ſcarcely attended to by ſurgeons. Now, if an accidental wound in any of the large branches coming off near to the axilla take place, or in the external thoracic arteries, and if the ſurgeon is not provided with inſtruments for taking hold of the bleeding veſſels, or if there is an aneuriſm in the axilla where there is no poſſibility of applying the torniquet in the ordinary way, or if we are taking off the ſuperior extremity at the joining of the humerus with the ſcapula, by making a preſſure here we may prevent the great loſs of blood.

CCCLXXVI.

Following the artery a little farther, we find it get into the axilla; and here it is protected by the pectoral muscle and latissimus dorsi, stretched across from the trunk to the body of the humerus, whereby the artery receives considerable protection, and the arm is much less wasted in persons that use crutches.

CCCLXXVII.

Next, from its situation between the round ball of the humerus and ribs, where a luxation happens downwards and inwards towards the axilla, the artery may happen to be very much compressed; and from this, independent of other circumstances, the arm may lose very considerably of its strength. From the pressure of the nerves here, a numbness is very often brought on, and this even continues sometime after the bone is reduced, the nerves being injured from the pressure it has suffered.

CCCLXXVIII.

Lower, we find the axillary glands connected to the artery by cellular substance; and where these are enlarged in a diseased state, there must be the utmost caution used in attempting to separate them from the artery, and the surgeon is under the necessity of tearing them away with the fingers, instead of using a knife.

CCCLXXIX.

Lower than this, the artery runs parallel with the os humeri, therefore is now named, humeral artery; and, in its whole courſe, is almoſt ſub-cutaneous, or is not covered by any conſiderable muſcle, but by the ſkin, cellular ſubſtance, and that condenſed with a thin aponeuroſis ſent off from the muſcle, ſo we can diſtinguiſh the ſtroke of it, through the whole way down the humerus, and are able to compreſs it in its whole courſe with the tourniquet; and the blood is more eaſily ſtopped here than ſurgeons generally apprehend. The tourniquet need not be drawn with great force, a very ſlight compreſſion may be ſufficient. And nature, in the whole courſe, has diſpoſed the artery in the place of the extremity that is evidently the ſafeſt, running down parallel to the biceps at the inner ſide of the humerus, where it is leaſt expoſed to injury. At the lower part of this bone, an addition is made from the tendon of the biceps; the aponeuroſis is now very conſiderably thicker.

CCCLXXX.

After the artery has run about ¼ of an inch under the bend of the elbow, it divides into the ulnar and radial branches; and following theſe into the hand, we find large communications of the arteries with each other; we find a ſuperficial and deep arch; or, ſuppoſe an oval, or a circle, to be

made by the arteries around the tendons of the hand, that circle into one ſide of the trunk of the radial artery is opened with a ſmall branch of the ulnar; and into the other trunk of the ulnar with a ſmall branch of the radial; ſo that the blood may flow freely from the radial artery acroſs theſe arches into the ulnar, and aſcend in the ulnar in its whole length. From this merely we might conclude, that where radial or ulnar arteries happen to be wounded, the ſurgeon cannot ſtop the blood by gently compreſſing the artery, or by ſqueezing the ſides of it together, but we may tie the wounded artery above and below the wound, and the circulation remains free through the whole member.

CCCLXXXI.

If the middle of the radial artery is wounded, all below would be ſupplied with the blood deſcending through the ulnar, and coming upwards from the arches into the radial. From the anaſtomoſes we ſee alſo the neceſſity there will be, where theſe are to be ſtopped by ligatures, of making two ligatures, otherwiſe the bleeding will deſcend through the other branches, and get back to the wound. Not but that the bleeding may ſtop of itſelf by the coagulation of the blood at the mouths of the veſſels; by their contractions, and by the ſwelling of the neighbouring parts, though it receives the direct impulſe of the heart, and it

may be ſtopped more readily by the ſame means where the impulſe is more indirect. But if we had no facts to ſupport us, we could ſcarcely venture to draw any further concluſion with regard to the danger of wounds made in the trunk of the humeral artery. Merely reaſoning upon it, we would ſuppoſe, that if the trunk is wounded, the limb under the wound could not be nouriſhed, becauſe the anaſtomoſes are ſo ſmall, that there could ſcarcely be a ſufficient quantity of blood for that purpoſe; but experience determines otherwiſe, and we know certainly, from a number of caſes, that after the humeral artery has been wounded, we may tie it in two places, and yet the motion of the blood continues through the arm in ſuch quantity as is ſufficient to maintain the common functions of the part. Hence, where a wound has been inflicted higher than the joint of the elbow, and there has been an uncommon diviſion and only one of the branches has been wounded, or that the wound is more general on the radial branch, the trunk is more expoſed than that branch, becauſe the ſkin is thinner at that place, at the place of our flexion, in conſequence of which the artery puſhes forwards, and it is ſupported on the ſwelling of the extremities of the bones; whereas the radial branch ſinks deeper between the muſcles, and begins lower than the place

from which furgeons generally draw blood. Thus, in moſt caſes, the trunk is found evidently opened; and, by the accounts of authors, the wound is always found to be ſeveral lines or parts of an inch above the diviſion. Or take another view where the operation even has been performed in an unguarded manner; the patient has ſuffered very exquiſite pain, becauſe the ſurgeon included the large radical nerve which is contiguous to the trunk, and, where the trunk divides, it follows the ulnar branch, not the radial; and the name of radial nerve ſeems to have miſled ſome who have not ſeen this argument.

CCCLXXXII.

Thus it is ſufficiently eſtabliſhed, that the fore arm can be nouriſhed by the lateral branches or recurrent veſſels, taking their riſe from the radial, ulnar, and interoſſeous arteries; and theſe gradually come to be dilated. Very often the dilatation is made before the operation is performed; and this explains a circumſtance which has appeared very perplexing to ſurgeons; that, immediately on making a preſſure upon the trunk of the artery by the ligature, the pulſe ceaſed in the veſſels at the wriſt, but in the ſpace of a few minutes it could again be felt. For in the time of the operation, without ſuppoſing the faintneſs, there is a loſs of blood, the veſſels are emptied, the ſurgeon ſlackens his tourniquet, then ties the thread, and it re-

quires ſome time before the blood has deſcended ſo as to convey the impulſe of the blood in the heart. But if the diſeaſe has continued ſuch a length of time as to make ſuch an enlargement of the trunk, if the tumor preſſes this artery againſt the bone, the branches will be dilated, ſo in a few minutes they are filled and the impulſe communicated. But where the preſſure is not conſiderable, ſo as greatly to interrupt the flow of the artery, the pulſation commonly ceaſes for ſeveral days, till the lateral branches come to be dilated. The recurrent branches have been even ſeen dilated to the ſize of the end of a common probe.

CCCLXXXIII.

Having thus proved that the trunk of the artery may be tied at the elbow, it may be concluded that that operation may be as well applied to any other part of the ſuperior extremity. Or, if we now return to the diſtribution of the veſſels, at the upper part of the arm we find a communication made nearly in the ſame way, a ſuperior, and poſterior ſcapular artery; and getting lower, we find a number of ſmall branches, &c. And to ſhew this more clearly by an experiment, the trunk of the humeral artery may be tied in two places, and cut between them, ſuppoſe about the middle. An injecting pipe is then to be fixed higher than the place cut, and ſquirting in water, air, or milk, we can feel all the inferior branches.

Thus the operation which is done near to the elbow, may be practifed any where in the upper part of the humerus with nearly the fame fuccefs, only a greater portion of the member needs to be nourifhed. And cafes have occurred that prove it in the moft abfolute manner. An aneurifmal fac has occafioned a concretion of the fides of the humeral artery near to the axilla, an effect the fame as that of the ligature, and a proof that the artery may be tied above this ruptured place. Even from this, however, it does not follow with an abfolute certainty, that any arm may be faved though the humeral artery is tied to that height; the concretion muft be gradual in proportion to the increafe of the aneurifmal tumor, fo the lateral branches will dilate by degrees; but in the cafe of a wound, the branches may not be fufficient to convey the neceffary quantity of blood. But, inftead of immediately proceeding to amputation, we fhould attempt to fave the arm.

CCCLXXXIV.

Having now attended to the common divifion of the artery, it is of ufe to obferve, that *lufus naturæ* are more frequent than anatomifts are aware of. Dr. Haller imagines that they have not been fo frequently obferved as they are defcribed. But inftead of that, fuch may happen, upon the whole, in one of twenty perfons; and a furgeon ought to look for it as in performing

the operation of the aneurifm; efpecially that the two branches may clofely accompany each other, and fo both may be taken up. But if the furgeon is aware of this, the two branches may be feparated with the greateft eafe, and the fuccefs of the operation thereby infured, though the fupply is the fame as where one of the arteries happen to be wounded. In fome cafes they are afterwards united by a crofs canal; but we are to take it for granted, that the fupply is made through the fmall anaftomofes or arch in the ball of the hand; and the neceffity of larger anaftomofes is evident, that part being more expofed to compreffion, and the ftagnation of the blood in the veffels.

CCCLXXXV.

One further *lufus naturæ* ought to be obferved, that it fometimes happens that where the common divifion is made, the arteries, inftead of remaining contiguous to each other, feparate, and one of them is fubcutaneous. There may be a danger, therefore, of opening an artery inftead of a vein; particularly we ought to be cautious where we are about to open the branch in the courfe of the bafilic vein.

CCCLXXXVI.

Having fully confidered what belongs to the arteries, let us next take the veins into review.

CCCLXXXVII.

All the confiderable arteries are accompanied by

correſponding veins. Theſe are more numerous than the arteries; taken together, they are larger; but taken ſingly, they are ſmaller: for there is no vein as large as the humeral artery for ordinary accompanying it, but two or more veins, and theſe frequently joined together, and the whole crouded with valves. Beſides the accompanying veins, there is ſeen a ſet of ſubcutaneous veins, which are upon the whole larger than the deep veins, and theſe likewiſe are crowded with valves, notwithſtanding that they run upon the ſurface of the muſcles, and we ſee numerous anaſtamoſes between the deep and ſubcutaneous veſſels. All the circumſtances clearly confirming, as with regard to the uſe of the valves, that they ſerve to determine the blood to the heart; that, although the moderate action of the arteries and muſcles promotes the flow of the blood in the veins; yet, if that action is greater, we ſtop the flow almoſt entirely. When the muſcles are acted with, the ſubcutaneous veins immediately ſwell, the blood being no longer able to get along the internal veins with freedom. Hence, in letting blood, the patient is directed to move the fingers; and if the motion made is ſlow, we ſee the blood flowing ſometimes in the ſubcutaneous veins, *per ſaltum*, and producing an alarm as if an artery had been opened. There is at the outer ſide the cephalic vein, upon the inner ſide the branch

forming the basilic, and between these, the median cephalic and median basilic. If then the situation of the arteries alone is respected with regard to the veins and the tendons, and if the tendons are very sensible, we would let blood most readily in the cephalic or median cephalic vein. But, if it shall appear that the tendons have little sensibility, and that the danger of wounds, independent of the artery, arises from punctures of the subcutaneous nerves, we would perform the blooding most frequently in the median basilic; and, as this vein is of considerable length, though it crosses the artery, you will always find room for opening it without making the orifice immediately over the artery: it does not run so much longitudinally, but we may keep it $\frac{1}{4}$ of an inch distant.

CCCLXXXVIII.

To finish the examination of the parts described, their nerves come last into review. The exit of the first nine pair or the cerebral ones, was already noticed. The 1*st* pair, or olfactory, the most tender in their structure of the whole, we found form a beautiful plexus spread out on the membrane of the nose. The 2*d*, or optics, of a pure white texture, enters the orbits in a waving direction, and penetrates the eye-balls, to be expanded on the retina. The third, or eye-movers, passing out at the foramen lacerum, divides into

branches which fupply the ocular mufcles, and form a fmall opthalmic ganglion. The *4th*, or pathetic, the moft flender of the whole, is diftributed on the trocholearis mufcle. The *5th*, or trigeminum, the largeft of the whole, forms the femilunar ganglion by the outfide of the cavernous finus, and from this ganglion fends out three large branches, the opthalmic and two maxillary, which are again divided into an infinite number of fubdivifions. The *6th* pair are expanded on the abductor mufcles of the eyes. The *7th* pair, next to the olfactory, is the fofteft nerves in the body, and is diftributed in two portions on the ear and face. The *8th* pair is fpread out on the neck, tongue, pharynx, and adjacent parts. The *9th* pair is diftributed chiefly to the mufcles of the neck and tongue.

CCCLXXXIX.

Great Sympathetic Nerve.

After this origin and primary diftribution of the cerebral nerves, falls to be noticed the great fympathetic, connected with moft of the nerves of the body, and arifing from a reflected branch from the *2d* of the *5th* pair, and from fome fmall filaments of the *6th* pair. It is expanded in its courfe along with fome other nerves into a large ganglion on the neck, termed the fuperior cervical ganglion. At the under part of the neck it forms in the fame manner another ganglion, termed the

medium, or inferior cervical ganglion, ſimilar in moſt reſpects to the former, but admitting ſome variety in different ſubjects. From this ganglion principal branches are ſent out, one of which, or the proper continuation of the trunk, paſſes to a 3*d* ganglion placed at the head of the firſt rib, and therefore the firſt of the thoracic ganglia. From all theſe ganglia a variety of nerves are ſent off to the different adjacent parts, and which derive their name from their connections or diſtribution.

CCCXC.

Acceſſory Nerves.

The acceſſory nerves to the 8*th* pair come the next in courſe, ariſing from the medulla oblongata and upper part of the ſpinal marrow. After perforating the cranium they obſerve an oblique deſcent through the ſterno-maſtoid muſcle to the ſhoulder, from which they ſend branches to different parts.

CCCXCI.

Spinal Marrow and Nerves.

We thus deſcend to the ſpinal marrow which is chiefly to be conſidered as the production of the lengthening out of the medullary ſubſtance of the brain and cerebellum; but, upon cutting it tranſverſely, a ſmall proportion of cortical or cineritious ſubſtance may be obſerved reſembling that of the brain. The nerves are next every where in the whole length of the ſpinal marrow

in pairs, and every nerve has two origins, an anterior and poſterior one. Bundles of threads compoſe the ſpinal marrow, and theſe are covered where they are about to go through the holes of the vertebræ by the dura mater, and at that place there is an enlargement, a ganglion or knot, bigger than the threads that form it, or than thoſe that go out from it. Beyond the knot we find the nerves ſpread into anterior and poſterior branches; the anterior are the largeſt, and all of them communicate with the nerve above and below. Now, from this circumſtance, it is in vain, till more pains are taken, to pretend to determine exactly the muſcles on which each pair of nerves terminates: we find all of them joined to one another.

CCCXCII.

The ſpinal nerves are diſtinguiſhed on each ſide by numbers, according to the bones under which they paſs. They proceed the length of 30 pairs. Of theſe, one paſſes under the head, termed ſub-occipital, ſeven go under the vertebræ of the neck, twelve under the dorſal vertebræ, five under the lumbar, and five are ſent from the pieces of the ſacrum.

CCCXCIII.

The faſciculi which compoſe theſe nerves, vary in the different diviſions in their length, and in the direction of their courſe; ſome running ſtraight,

and others running oblique. The ſize alſo of the faſciculi correſponds to that of the nerves they go to form. The lumbar, and ſeveral faſciculi included in their covering, compoſe a bundle of cords, termed the cauda equina, from its reſemblance to a horſe's tail.

CCCXCIV.

The circulation of the ſpinal marrow is ſupplied by its own arteries, the anterior and poſterior ſpinal ones, which receive many additional branches from the adjacent parts.

CCCXCV.

The anterior ſpinals ariſe from the vertebrals; and upon the beginning of the ſpinal column they unite into a common trunk, and the artery continues nearly of the ſame ſize throughout, receiving additions from the neighbouring veſſels. In the neck the ſpinal trunk communicates with the vertebral, thyroid, and cervical arteries. In the back it receives branches from the intercoſtal, and in the loins from the lumbar arteries. It terminates at the under end of the ſpinal marrow.

CCCXCVI.

The poſterior ſpinals ariſe from the arteries within the head. They are of the ſame length with the anterior, but are leſs in ſize, and continue ſeparate through their whole courſe. They obſerve alſo a ſeparate direction, and frequently

inoſculate with trunks connected with the anterior ones.

Theſe arteries of the ſpinal marrow are ſubdivided into moſt minute diviſions ſpread upon every part of its ſubſtance and its membranes.

The veins accompany the arteries, and terminate in the venous ſinuſes of the ſpine.

CCCXCVII.

Theſe ſinuſes conſiſt of one on each ſide, which runs exterior to the dura mater lodged in the ligamentous membrane which lines the vertebral canal. They extend from the occipital foramen magnum to the under end of the os ſacrum, and from their irregular appearance and ſubdiviſions, they in many places poſſeſs the appearance of cells. At the different vertebræ they are conjoined by croſs branches of a ſemilunar form, and at their upper occipital extremity they communicate with the occipital and lateral ſinuſes of the head.

CCCXCVIII.

From the ſpinal nerves, now conſidered, we proceed to thoſe of the neck. And, in general, we obſerve of the ſpinal nerves, which take their riſe from the ſpinal marrow, that they begin by two diſtinct bundles of fibres, an anterior and poſterior bundle. Theſe come to be joined together, and are covered by the dura mater; but further, where they meet, there is a knot or ſub-

ſtance, which anatomiſts call ganglion, the nature of which is not perfectly underſtood. From the ganglion branches are ſent off, and all the anterior branches are connected by arches, which repreſent the anaſtomoſes of blood veſſels, but are perhaps very eſſentially different. From theſe are bundles of them tied together in one ſheath.

CCCXCIX.

Beſides the connection which the cervical and ſpinal nerves have by their anterior branches, the neck produces alſo, as already noticed, a nerve named acceſſory, which runs upwards into the head, comes out with the eight pair, is again connected with the other cervical nerves, and, laſtly, all the cervical nerves are joined to the great ſymphathetic, or intercoſtal one.

CCCC.

The general purpoſe of this is, to prevent the nervous energy from being intercepted; which is fully diſplayed in the lower cervical, or brachial nerves, which are firſt joined together by their anterior branches, and afterwards ſeparated again, and a ſecond and third time reunited; or we obſerve a very curious plexus formed by them under the clavicle, and down into the axilla, what anatomiſts have named axillary plexus. It is no greater an enlargement than what might have been expected from the ſize of the nerves running

together; and we can diſtinctly trace the nerves through the plexus, ſo as to determine the nerves of the neck from which every muſcle is ſupplied. Thus, if from two nerves, ſuppoſe the two firſt, the fourth, and fifth of the neck, nature intends to ſupply two muſcles that are antagoniſts, the biceps flexor and triceps extenſor, inſtead of the fourth nerve ſupplying the one, and the fifth the other, the half of each is ſent into each muſcle, and neither the fact nor reaſon of it has been properly attended to. It is plain that this is to guard againſt accidents; that if one nerve is divided, inſtead of loſing altogether the uſe of the flexor, or extenſor muſcle, we loſe the half of both; and it is better to be able to extend and bend the arm with half the force, than to have the whole flexion without the power of extenſion. It is not to enable us to act more freely; there is no foundation for that ſuppoſition. We find it univerſally maintained, that the ſuperior trochlearis muſcle receives a nerve, that we may act readily and eaſily with that. But there is ſome other ſecret purpoſe to be ſerved; and we find the nerves ſupplying different muſcles carefully united, the union repeated, and antagoniſt muſcles ſupplied from the ſame roots, and the ſame muſcle, when of unuſual length, ſupplied from a number of nerves.

CCCCI.

Nerves of the Superior Extremity.

The cervical nerves, in getting into the axilla, form an irregular plexus, termed the axillary, or brachial, which ſurrounds the place of the artery; and this plexus ſends branches to a number of the muſcles, and furniſhes alſo the external thoracic nerves: after this it divides into nerves of great ſize, which ſupply ſenſation and energy to the ſuperior extremity. Their number is conſiderable, and their diſtribution intricate and extenſive. When the principal or radial nerve reaches the hand, it comes off in three diviſions, from which ſeven nerves of conſiderable ſize ariſe for the ſupply of the thumb and fingers. When the ſecond branch or ulnar reaches the ſame place, it is chiefly expended on the back of the hand. Beſides the brachial plexus ſupplying the ſuperior extremity, this member alſo derives ſome addition from the intercoſtals.

CCCCII.

On the nerves of the ſuperior extremity it may in general be obſerved, that the uſe of knowing their particular ſituation is evident, as in treating various caſes of convulſion and paralyſis, and in performing ſurgical operations, that we may avoid them, becauſe they are never wounded or punctured without evident danger. And in proof of this, we need only attend to the bad con-

ſequences from wounds of the ſmall branches, and particularly thoſe following blood-letting performed about the elbow.

CCCCIII.

From the extremity, we return to trace the nerves of the thorax, which, on each ſide, conſiſt of the phrenic, or diaphragmatic part of the *8th* pair, the great ſympathetic, and the intercoſtals. Of theſe, the intercoſtals and diaphragmatics ſupply the pleura, or inveſting membrane, with ſmall twigs. The heart, the principal organ, derives its energy chiefly from the great ſympathetic and *8th* pair; and from the ſame ſource is ſenſibility conveyed to the lungs. In the diſtribution of the nerves here, ſeveral important plexus are formed. The *1ſt* is the anterior pulmonary plexus, which extends acroſs the great branches of the pulmonary artery. The *2d* is the poſterior pulmonary plexus, which lies behind the root of the lungs. The *3d* is the œſophageal plexus, which ſurrounds the œſophagus, and afterwards going through the diaphragm, is ſpent upon the abdomen. The *4th* is the great cardiac plexus, formed by a number of nerves, and particularly neceſſary to the exerciſe of the functions of the organ. Beſides which, we find a leſſer cardiac, and two coronary plexus.

CCCCIV.

Thus the heart, as the principal organ, receives its ſupply from no leſs than thirteen ſeparate

twigs or branches at leaſt; and, beſides the nerves that deſcend, we are not certain but there may be others that aſcend and enter into the ſubſtance of the heart. Upon the whole, we can obſerve, that nature carefully guards againſt the want of a proper energy. Thus, if from any accident or diſeaſe a part of its force ſhould be loſt, it is better that this ſhould be general, than that any one part ſhould be rendered paralytic. Hence the heart derives its nerves from a number of organs, and theſe are intermixed by the intervention of ganglia, a further energy proceeding perhaps from theſe.

CCCCV.

From the conſideration of the importance of the organs upon which theſe nerves are ſpent, the danger of wounds in the nerves upon the neck is perfectly evident. If a conſiderable proportion of them is tied, the animal ſoon dies; and, independent of the danger which attends the ligature or diviſion of theſe nerves, we have reaſon to believe that there is the utmoſt danger to be apprehended where the *8th* pair and intercoſtal run, upon their being expoſed to the air, from an inflammation taking place, that alone will be found often fatal. Hence we are not raſhly to undertake operations here. As for the aneuriſm in the carotid artery, ſuppoſing it to be ſmall, and that it is in the ſurgeon's power to tie the artery in

two places by ſuch a ligature on the carotis communis the animal has been known to ſurvive; but, when any greater injury is done, the animal dies, and in ſuch caſes theſe nerves are in an inflamed ſtate, and glued to the neighbouring organs.

CCCCVI.

When we compare the branches from the 8*th* pair with the proper doiſal or intercoſtal nerves, we obſerve a great diſproportion. Perhaps all the branches from the 8*th* pair on one ſide are not equal to the ſize of one of the proper dorſal nerves: and from this we may in ſome meaſure underſtand what happens in practice. It is a point allowed, that what is called the pleuriſy, the inflammation of the ſide of the containing parts of the thorax, is attended with more pain and harder pulſe than the true peripneumony, where the inflammation is in the ſubſtance of the lungs. This may be in ſome meaſure explained. Several circumſtances no doubt concur; but, without taking into account the difficulty ariſing from the inflammation with which the blood paſſes from the right ſide of the heart to the left to affect the pulſe, we would ſay that, from the greater number of nerves ſent to the ſide, its ſenſibility is greater, and the ſyſtem more irritated. And one thing further, perhaps, may have effect, that the proper dorſal nerves are intimately connected to the

nerves which ſupply the heart. Though, therefore, we do not ſay that the ſympathy depends upon the connection of the nerves in their progreſs, yet an inflammation fixing upon a branch, more readily affects the neighbouring branches than the diſtant nerves of the body. Hence the hardneſs of the pulſe, and the quick jirk, is owing very much to the ſenſibility from theſe large nerves, which too is the cauſe of the pain.

CCCCVII.

The whole ſubſtance, indeed, of the lungs does not receive a nerve larger than one of the proper dorſal nerves, the diviſions of it therefore muſt be exceedingly minute, and the nerves of the pleura very ſmall. This is to be ſuſpected from conſidering the uſe of the pleura, which, with reſpect to the lungs, is to give a ſtrength to them to confine the air, and prevent a rupture. Another uſe is, that the lungs in reſpiration may play upon the ribs, the pleura is interpoſed to leſſen the attrition, ſo that it is made for attrition. Now, do we perceive, either from the one uſe or other, any neceſſity for ſenſibility? A highly ſenſible membrane cannot be interpoſed for either purpoſe.

CCCCVIII.

Upon the whole, though the pleura has nerves, becauſe it has veſſels which are actuated by the nerves, yet theſe are ſmall and inconſiderable in

number, yet it is capable of inflammation and of concretion, which may be the ſource of many diſorders; but we are not to believe that merely the inflammation of the pleura is capable of occaſioning fatal ſymptoms, and that theſe depend almoſt entirely upon the affection of the nerves of the ſide, which are large and numerous, and which it is not in our power to relax, and which we cannot altogether refrain from uſing. Where the pain is ſeated entirely in the lungs, the patient will ſuffer the higheſt degree of danger when the inflammation occupies the deepeſt part of the lungs, both on account of the ſenſibility of the trachea, and of the diſtribution of the nerves from the 8*th* pair.

CCCCIX.

Nerves of the Abdomen.

The nerves of the chylopoetic viſcera are formed by part of the 8*th* pair, and of the great ſympathetic.

The covering, or peritonæum, derives branches from all the contiguous parts, but their number is ſmall, and they are unimportant: they conſiſt of twigs from the inferior dorſal, the lumbar, the great ſympathetic, and ſacral.

CCCCX.

The two nerves compoſing the 8*th* pair, after ſupplying the lungs, run upon the æſophagus. In their courſe downwards they ſplit into branches,

and from the oppoſite ſides the branches are united. That branching and joining is repeated ſeveral times before we get down to the ſtomach, ſo that we are at a loſs to determine from which ſide a nerve of the ſtomach comes; in general they come from both ſides. And we find an anterior and poſterior bundle called plexus; but we are only to underſtand that ſeveral nerves are included in the ſame ſheath, but without knots or ganglia being formed. The remainder of the 8*th* pair paſſes from the back part of the ſtomach to the aorta, and joins it as ſoon as poſſible about the root of the cæliac artery.

CCCCXI.

In tracing the great ſympathetic, it runs down the thorax, and is joined to the proper intercoſtal nerves. About the middle of the thorax branches are ſent off, which uniting, form a conſiderable nerve that is ſpent almoſt entirely upon the abdominal bowels, ſo named the ramus ſplanchnicus. The rami ſplanchnici take the ſame direction with the poſterior branches of the 8*th* pair, and they are joined to each other acroſs the aorta, and at the ſame time they receive the 8*th* pair, ſo that three nerves meet about the cæliac artery; and at the meeting we find a prodigious enlargement without any evident cauſe, we would ſuppoſe that it is a cluſter of ſmall conglobate glands, or we

ſind ganglia, and from its appearance it is called the ſemilunar ganglion.

CCCCXII.

From this ganglion nerves are ſent off to all the chylopoetic viſcera; and, as theſe ſcatter as they proceed towards the different bowels, there are others who call this ſubſtance plexus ſolaris, like the ſun ſending out radii to all ſides. The nerves from it proceed along the arteries, are conducted by them, forming a net-work that we would take for cellular ſubſtance, and take their name from the arteries they accompany, as the plexus cœliacus meſentericus.

CCCCXIII.

This ſemilunar plexus in which the ſeveral nerves are united, is much larger than we might have expected, or ſomething more is done here than in ſeveral other plexus, where we can trace the fibres diſtinctly, whereas here we loſe them. And, without ſuppoſing that there may be ſomewhat added to the nervous energy in the part, or that ſome purpoſe is ſerved different from what the brain itſelf ſupplies, we find here an intimate mixture and incorporation of all the branches running downwards, nature guarding againſt the total interruption of the nervous energy in organs that are neceſſary to life. Thus it is better to loſe the thirtieth part of the nervous energy of

the alimentary canal, than to loſe the total power of the thirtieth part of the length of it; for, ſhould a paralyſis of a ſingle foot of it take place, there would be an interruption to the diſcharge of the aliment, the action of the muſcular coat of the alimentary canal contributing in a very principal way to this. So we may ſay, that in the ſemilunar ganglion there is an intimate mixture of the ſeveral nerves, and we may conſider theſe nerves as derived from a number of ſources, from the intercoſtal, connected with all the nerves of the ſpinal marrow, and ſeveral from the head; and the nerves may aſcend from the lower parts of the ſpinal marrow, ſo that ſome of the nerves entering this ganglion may be derived from the bottom of the os ſacrum. From the nerves every where accompanying the arteries, upon coming out from this plexus we can underſtand the danger ariſing from tumours near to the arteries, as in the caſe of aneuriſm, there is not only danger from it as affecting the artery, but from the accompanying nerve neceſſarily ſuffering.

CCCCXIV.

In conſidering the different abdominal organs, the nerves of the ſtomach we find moſt numerous in the cardia. The nerves of the ſtomach ſupply alſo the omenta. Of the inteſtines, the nerves of the ſmall ones are moſt numerous. In the liver, the ſame obſervation may be made, compared

with many of the other viſcera. In the ſpleen, the nerves are both numerous, and form an irregular plexus ſurrounding the blood veſſels. In the pancreas, again, they are ſmall. In the kidneys, like the ſpleen, the nerves are both numerous, and they form a plexus which ſurrounds the veſſels, and accompanies them. This plexus ſends alſo branches to the renal glands. The bladder of urine is ſupplied by the ſacral nerves and great ſympathetic.

CCCCXV.

To finiſh our examination of all the organs contained in the thorax and abdomen, one only remains, which has been hitherto purpoſely omitted, as the reſervoir of a particular ſyſtem of veſſels, the detail of which we as yet poſtpone.

CCCCXVI.

This is the thoracic duct, a ſmall membranous-like canal lying in the back part of the thorax, and forming the principal trunk of the abſorbents.

CCCCXVII.

Thoracic Duct.

It is ſituated behind the aorta, beginning upon the 3*d* vertebra of the loins, and it croſſes obliquely from left to right till it gains the right ſide of the artery. Thus ſituated, it forms an oval ſac, the receptacle of the chyle; and paſſing between the crura of the diaphragm, it aſcends in the thorax on the anterior part of the ſpine, between the

layers of the mediaſtinum. At laſt croſſing behind the upper part of the deſcending aorta, it emerges from the thorax to reach the under part of the neck. There it paſſes behind the internal jugular vein ſomewhat higher than the ſubclavian, and turning downwards, compoſes an arch ending in the cavity between the left jugular and ſubclavian. Into this duct is poured the chyle and lymph from all the colourleſs, or lacteal, and lymphatic veſſels, to be diſcharged, as we ſhall afterwards find, into the red veins.

CCCCXVIII.

Having thus traced the circulation of the aſcending and deſcending aorta, and the ſeveral organs they pervade, we again return to the abdomen to examine the organs of generation peculiar to the ſexes, which ſtill remain.

CCCCXIX.

Genital Syſtem of the Male.

In beginning the genital ſyſtem of the male, our demonſtration commences with the teſtes, which are two glandular bodies ſituated in the cavity of the ſcrotum, the body of the one being ſometimes a little larger than that of the other.

CCCCXX.

This part, the ſcrotum, is a continuation of the common teguments, more abundantly ſupplied with ſebaceous follicles than elſewhere, without any fat in its cellular ſubſtance, and forming a

bag, or purſe as it were, over the teſticles. Upon its ſurface there is a ſuperficial longitudinal projecting line, which divides it into two equal parts, and is named its raphe. Its inner lining, or cellular ſubſtance, is red, fibrous, and more condenſed than elſewhere, receiving the name of dartos; and forming a partition, or involving each teſticle ſingly, ſo as to prevent any direct communication by means of a fluid or otherwiſe betwixt the two. By this outer covering of the ſcrotum are the teſticles ſupported and protected.

CCCCXXI.

Whether there be a foundation for the term of dartos muſcle, for expreſſing a muſcle under the ſkin of the ſcrotum, is doubtful. We ſee the part poſſeſſed of conſiderable power of contraction, and we obſerve a degree of redneſs here, but we ſhall find, perhaps, that there is more muſcular power in our body than we are aware of. In particular, every part of our ſkin is muſcular, for it accommodates itſelf to heat and cold in the living differently from what it does in the dead body; but the motions of the teſticle within the ſcrotum, particularly when the ſcrotum is inflamed, does not depend upon the dartos ſo much as upon the cremaſter muſcle, which has ſuch a connection with the cellular ſubſtance, that the ſkin ſeems to be moved by it, and it may promote the ſecretion as well as the excretion of the ſemen. The ſep-

tum ſcroti may be conſidered as cellular ſubſtance, grown more denſe by having the layers preſſed againſt one another.

CCCCXXII.

The internal coats proper to each teſticle, ſerve alſo ſomewhat for the ſame purpoſe as the ſcrotum. Theſe are the vaginalis and albuginea.

CCCCXXIII.

The vaginal coat is a continuation of the peritonæum, or abdominal covering, originally deſcending with the teſticle, and forming a ſheath, or ſhut ſac round it, which has no communication with any other part. In its manner of incloſure it reſembles the pericardium of the heart, lying every where looſe upon it, except where it is connected with the albuginea behind; and to ſuch an extent is that looſeneſs both above and below, as to allow a proper and free motion of the organ. By its external ſurface it is attached to the cremaſter muſcle, and thus to the inner ſurface of the ſcrotum. It aſſiſts, as already noticed, in the ſupport of the teſticle; and, by a ſecretion from it, is the free motion of the organ preſerved.

CCCCXXIV.

Within the vaginal covering is the albuginea, or white coat, which proceeds alſo from the peritonæum, and cloſely inveſts the body of the teſticle, to which, internally, it every where firmly

adheres. It is a denſe, ſtrong, inelaſtic membrane, of a ſmooth external ſurface, every where ſpread over the teſtes and epididymis, and conducting their veſſels in the ſame manner as the meſentery does thoſe of the inteſtines.

CCCCXXV.

The body of the teſticle next exhibits a yellowiſh colour, and a pulpy appearance, of an oval form, with one ſurface a little flattened.

CCCCXXVI.

Epididymis.

At the outer and back part of the teſtes lies their appendix, or the epididymis, incloſed in the ſame covering with the teſticle itſelf. This part joins at the upper part of the teſticle by a rounded head. As it deſcends it becomes flatter and ſmaller, being attached behind to the body of the teſticle where blood veſſels enter; but at its fore part it remains looſe, the tunica albuginea dipping here and forming a pouch. From the under part, where it forms by its firm attachment to the body of the teſticle the cauda minor, it turns backwards, and ſends out the excretory duct of the teſticle.

CCCCXXVII.

The body of the teſticle, when examined, is formed of numerous veſſels of every deſcription, but its principal compoſition is a collection of ſmall tender elaſtic filaments, intricately convoluted, termed the ſeminal veſſels, or tubes; and

difpofed in bundles with partitions between them, formed of vafcular and cellular fubftance.

CCCCXXVIII.

The commencement of thefe partitions is at the root, or near the back part, of the tefticle; and they extend in a radiated manner to the albuginea. Behind, the tefticle is fixed by its veffels, forming the fpermatic chord. Before, it is loofe and free. From the ring of the external oblique mufcle, the chord extends to the body of the tefticle, being the united trunks of the different veffels of the tefticle increafed by a quantity of cellular fubftance. The cremafter mufcle alfo covers the chord, and the peritonæal continuation internally from the vaginal coat is fo clofely connected as to form a part of it. By the manner in which thefe coats are fpread no fluid can pafs from the chord to the tefticle, or take the oppofite direction. The circulation of the tefticle takes place by means of the fpermatic arteries which arife on each fide from the fore part of the aorta, a little below the renal arteries. They crofs the pfoas mufcle and ureter, and defcend to the under part of the belly behind the peritonæum, where perforating the ring of the external oblique, they pafs into the fpermatic chord. In their paffage they give branches to the adjacent parts, and are much interlaced with their correfponding veins.

CCCCXXIX.

After this paſſage of the rings, they ſoon divide into very ſmall arteries for the ſeveral parts of the teſticle, to the amount of four or five. Two of theſe go to the epididymis, and two large ones to the teſticle; one of which moves in its upper part in a beautiful ſerpentine form under the epididymis, and ſends coronary branches down all over its ſurface. The ſubdiviſions of theſe are at laſt minutely diſtributed upon the ſurface of the ſeminal tubes.

CCCCXXX.

Beſides the ſpermatics, a ſmall branch from the hypogaſtric accompanies the vas deferens, and is diſperſed along with the other artery.

CCCCXXXI.

The veins of the teſticle are greatly larger than the correſponding arteries, and diſcover ſeveral valves in their diſtribution without the abdomen. They form a plexus on each ſide of the artery, ſo as to reſemble the ſhoots of a vine. As it aſcends in the abdomen, it forms at laſt into a ſingle trunk on the right ſide, terminating in the vena cava, and on the left ſide in the renal vein.

CCCCXXXII.

To enter more minutely into the ſtructure of the teſticle, we find the ſeminal tubes of a cylindrical form, dividing into branches, and when drawn

out they extend to an amazing length. They are collected firſt into larger, and then into ſmaller bundles, till each of the ſmaller is formed into a ſingle tube, coiled up in a conical form; and from the convoluted tubes, ſtraight veſſels, or vaſa recta, are ſent out in equal number, forming an irregular plexus, or net-work, termed rete vaſculoſum. This net-work ſends out again from 12 to 18 ſtraight tubes, or vaſa deferentia, which carry the ſemen from the teſticle to the epididymis. Theſe ſtraight veſſels then become convoluted, and form conical bundles, or coni vaſculoſi, firmly connected by cellular membrane, and which compoſe more than a third part of the epididymis. They at laſt unite into a ſingle tube, which, conſtituting the moſt of the epididymis, forms the paſſage for the tranſmiſſion of the ſemen. In its courſe it enlarges, becomes leſs convoluted, and, expanding its ſtructure, it comes out in a ſtraight direction, under the name of the vas deferens.

CCCCXXXIII.

Veſiculæ Seminales.

From the epididymis, we are led to the veſiculæ ſeminales, two pyriform receptacles, ſituated between the bladder and rectum, at a conſiderable diſtance from each other, and each compoſed of a convoluted tube with irregular proceſſes, ſurrounded by veſſels, nerves, and cellular membrane. Internally, they conſiſt of irregular cells,

which communicate freely with each other, though varying in ſize and appearance in different ſubjects.

CCCCXXXIV.

Between theſe veſicles the vaſa deferentia become cellular, and expand, paſſing forward till they arrive at the proſtate gland, where they freely communicate with each other. Here a ſmall canal is ſent out from each of them, which pierces obliquely the proſtate gland, and terminates in the under part of the neck of the bladder. The orifices of theſe canals are ſeparated from each other by a caruncle, or round projection of the membrane of the urethra, termed the veru montanum.

CCCCXXXV.

Proſtate Gland.

The proſtate gland lies immediately under the ſymphyſis of the pubis, reſting upon the rectum. It cloſely embraces the neck of the bladder and beginning of the urethra. In ſize it is equal to a walnut, and in ſhape like a heart on cards, with its baſe to the bladder, and point to the penis. It is a firm gland, with ſome ſpongy ſubſtance, and it ſends out no leſs than 10 or 12 ducts, which open obliquely at the ſides of the urethra and adjacent parts.

CCCCXXXVI.

The circulation and nerves of theſe parts is

ſupplied by the ſame veſſels that ſupply the genital ſyſtem in general.

CCCCXXXVII.

In examining the uſes of the parts deſcribed, we find, that while the convoluted ſtructure of the teſticle ſeparates the ſemen from the ſpermatics, it is carried to the epididymis, and thence through the vas deferens by a long and ſlow courſe into the veſiculæ ſeminales. The uſe, however, of the veſiculæ ſeminales is undetermined, and they are ſuppoſed rather to ſeparate a particular mucus eſſential to the perfection of the ſemen in its paſſage, than as ſerving merely for a receptacle of it. The ſecretion of the proſtate gland ſerves alſo in a ſimilar manner ſome uſeful purpoſe, of which conjecture only can be formed.

CCCCXXXVIII.

Thus the ſemen paſſes upwards through the teſticle, then through the epididymis, to be depoſited in the veſiculæ ſeminales, into which it regurgitates from the vas deferens, as the gall to the gall bladder from the liver; and, by a reverſe motion, when neceſſary, it is thrown into the urethra. Near to the mouths of the ſeminal ducts we find the mouths of the proſtate glands opening; and alſo Cowper's glands, the nature of which we do not pretend to explain: and in the whole courſe of the urethra, we find tubes pouring out mucus to defend the paſſage from the acrimony of the

urine, which, as it advances, preſſes out the mucus from them; and theſe are, beyond all doubt, generally affected in the gonorrhæa, though that diſeaſe may alſo affect the other parts.

CCCCXXXIX.

Penis.

The penis, the next part that follows, is compoſed of three ſpongy ſubſtances, two of which form the body of the penis, or the upper part, termed its corpora cavernoſa, and the third ſurrounds the urethra, named its ſpongy body. They are all covered with a continuation of the common teguments, which are thinner than elſewhere, and which poſſeſs below a quantity of cellular membrane without fat.

CCCCXL.

Theſe teguments form at its anterior extremity a looſe fold, named the prepuce, which is connected to the glans, or under and anterior part, by a triangular fold or bridle, termed the frænum.

CCCCXLI.

In their ſhape, the corpora cavernoſa reſemble two irregular cylinders cloſely applied to each other, covered by a ſtrong ligamentous ſheath with tranſverſe and oblique fibres. They ariſe alſo by two crura, or conical extremities, from the crura of the oſſa iſchii and pubes, to which they are connected by ligamentous ſubſtance. At the

under part of the ſymphyſis they form a union which continues till they terminate in the glans or rounded extremity.

CCCCXLII.

From the upper part of the root of the penis proceeds a triangular proceſs, connected to the ſymphyſis, and named the ſuſpenſory ligament of the penis, by which its body is ſupported, and its preſſure upon the ſcrotum prevented.

CCCCXLIII.

The principal vein of the penis runs in a groove in the upper part of the corpora cavernoſa, and below in a channel left for the urethra. The internal ſtructure of the corpora cavernoſa is ſimilar to the cancelli of the bones, and conſiſts of looſe reticular plates freely communicating with each other. Over the cavernous cells the arteries are freely diſperſed, and open into them ſo as fully to fill them when diſtended, and to tinge them in the relaxed ſtate. The junction between the corpora cavernoſa is made by a continuation of their elaſtic covering, which forms a ſort of partition, and this partition is compoſed of cords that run in a parallel direction from the upper part of the penis to the urethra. Between theſe cords fiſſures are left for the paſſage of the blood without obſtruction.

CCCCXLIV.

The ſpongy body of the urethra lies under the

corpora cavernofa, and projects beyond them. It begins beyond the union of the corpora cavernofa, and terminates at the extremity of the glans. Its external covering, though the fame, is more delicate than that of the corpora cavernofa. The pofterior part of it, fituated within the fkin of the peritonæum, and extending from the root of the penis to near the anus, is dilated into a longitudinal prominence of a conical form, termed the bulb of the urethra, divided anteriorly by a feptum.

CCCCXLV.

The glans, or termination of the fpongy body of the urethra, anteriorly is feparated from the corpora cavernofa by a continuation of their ligamentous fheath, and is encircled by a prominent margin pofteriorly, termed the corona glandis, behind which is the neck. The furface of the glans confifts of a venous plexus, and nerves continued in a fine membrane from the infide of the prepuce, which give it fenfibility. The cervix and corona of the glans is befet with febaceous follicles or glandulæ odoriferæ. The internal ftructure of thefe parts refembles that of the corpora.

CCCCXLVI.

The urethra, the next part, is a long canal, in diameter the fize of a writing quill, terminating by a longitudinal orifice at the point of the penis,

after running from the under and forepart of the bladder through the corpus ſpongioſum. It deſcends ſomewhat at its origin, and then paſſes under the ſymphyſis, to which it is cloſely attached by cellular ſubſtance. Three dilatations of it are commonly obſerved in the courſe of the penis: one at the proſtate, the ſecond in the bulb, and the third at the commencement of the glans. Theſe are equalled by the ſame number of contractions, and this irregular ſtructure, along with its particular uſes, renders it ſo liable to diſeaſe. Between the point of the proſtate and part where the urethra penetrates the corpus ſpongioſum about a finger's breadth, the ſtructure is chiefly membranous, covered only by cellular ſubſtance. At the upper ſide the urethra becomes incloſed in the corpus ſpongioſum, which continues to its termination.

CCCCXLVII.

The lining of the urethra internally is highly vaſcular and nervous, with ſome ſlight power of contraction. Between the corpus ſpongioſum and this membrane, eſpecially towards the ſeptum, numerous lacunæ, of different ſizes, are placed; ſome of which, near the glands, are very large. They obſerve a longitudinal direction from behind forward, and perforate the urethra by ſmall orifices diſcharging a thick mucus to defend it from irritation.

CCCCXLVIII.

Besides the lacunæ between the bulb and prostate gland, two small bodies, covered by the accelerator muscles, are frequently met with, having ducts into the urethra, and serving the same purpose with the lacunæ, named Cowper's glands.

CCCCXLIX.

Having examined the structure of the male organs, the use of the several parts naturally comes into detail, and chiefly the vessels and the ducts of the seminal organs. The first thing that strikes us, is the situation of the testes, originally within the body, and the length of the spermatic artery running so far before it terminates on the testicles. Some, of late, would persuade us, that there is nothing singular in the length of the spermatic artery, that it takes its rise from the place nearest to the testicle of the fœtus, and is afterwards drawn out from necessity. Now this notion is to be rejected; for the spermatic artery of a ram shews the same structure, and displays also vast numbers of convolutions which it makes in its descent to the testicle. By a calculation, if it was drawn out to a straight line, it would measure about 20 feet. And we find that this artery is larger at the testicle than at its origin, notwithstanding that it gives off a number of branches. This arrangement cannot

be ſuppoſed to be made in vain; we muſt conceive that a change is made neceſſary for the preparation of the ſemen, that the length of the artery is of uſe in a manner that we cannot pretend to ſpecify. From this view in other animals, we are tempted to draw a ſimilar concluſion with regard to it in man, where we would have expected to find it taking its origin half way between its original place in the abdomen and its after place in the ſcotum, *i. e.* about the bottom of the iliaca communis. So that ſome change is made on the blood in its deſcent depending upon the unuſual length of the artery, and therefore we may admit a name applied by the ancients chiefly to the veins, calling them venæ preparantes: we may conceive that the artery does prepare, or begin to make changes fit for the ſeparation of the ſemen, before it reaches the gland.

CCCCL.

In next examining the vein, it bears an uncommon proportion to the artery. Perhaps ſome further uſe is to be derived from the numerous large veins favouring the return of the blood to the heart; and we obſerve from experience, that that vein is more apt to grow varicoſe than almoſt any other in the body. In ſome perſons it is ſwelled to ſuch a bulk as to ſtretch the ſkin of the ſcrotum; ſo it may be miſtaken for a rupture, or other complaints; but if we apply rhe hand to

the ſcrotum, the ſwelling is unequal, and it gives a feel different from that of a hernial ſac, or one filled with water.

CCCCLI.

We diſtinguiſh a number of chords, and all of them ſoft, and we find the ſwelling running the whole length of the chord; and, in the horizontal poſition, it in a great meaſure ſubſides; and raiſing the body, the ſwelling gradually increaſes, and the blood enters the vein from beneath upwards. Tracing the minute branches, we find them entangled together; ſo they were thought uncommon anaſtomoſes, but the injections keep their courſe; and we can give a general redneſs to the ducts within the teſticle, and we find conſiderable arteries dividing minutely upon the ſeminal ducts.

CCCCLII.

With regard to the ſeminal ducts, the bulk of the teſticle is very much owing to a number of threads convoluted, which, from injection, we find to be hollow tubes. Meaſuring the ſize of theſe tubes, and examining the general bulk of the teſticle, we find, that if the whole teſticle were ſuppoſed to be formed of ſuch tubes, the length would be nearly equal to 50,000 feet, or near to a mile in length. Now we cannot accurately determine how much of the real bulk depends upon the red blood circulating in the veſſels, but

it is evident that much more than the one half of the bulk is owing to the ſeminal ducts, and the length of theſe is not leſs than 3000 feet in each teſticle.

CCCCLIII.

The next point is the number of ducts entering into the compoſition of the teſticle, which is not ſo very difficult to be determined as might be imagined; becauſe in the teſticle there is a ſtructure that is altogether ſingular. We find a number of ſmall ducts joining into larger ones in other glands, and therefore the duct continually increaſing; but here the ducts run parallel to each other, without any anaſtomoſes, or any diviſion, or any gland or knot from which they are derived; ſo we need only attend to that end which communicates with the epidydimis, and we can reckon 150 different ducts; and ſuppoſing that the mercury has not filled more than the half, there are 300 ſuch tubes compoſing each of the teſticles, ſo that each may be about 10 feet in length. Theſe are every where convoluted in ſuch a manner, that we trace the courſe with difficulty; and the blood veſſels divide upon the ſurface, and perform the ſecretion in a particular manner. A coloured matter is even ſeen to paſs from the artery into the tubes, though we fill them with the utmoſt difficulty.

CCCCLIV.

Now each of the tubes may be ſcarce the two hundredth part of an inch when filled with mercury, which increaſes their diameter nearly double; and we can trace the courſe of theſe ducts the whole way to the veſiculæ ſeminales. The diviſion of theſe convoluted and ſerpentine tubes is not merely formed by blood veſſels, but there are thin layers of the tunica propria, or albuginea, which ſlide in between, dividing one bundle from another, though not in a regular manner, as an orange is divided by ſeptula. When theſe tubes run to the upper and back part of the teſticle, they become ſtraight; we find vaſa recta that come out of them, and there they communicate; or there is a rete teſtis, or the ſeveral ducts of the teſticle that communicate juſt within the tunica albuginea adhering to it; and we find a number of vaſa recta coming out, and conveying the ſemen into the epidydimis, ſo called vaſa efferentia, the number from twelve to fifteen or eighteen. After running a little way, they become convoluted. Now theſe coni vaſculoſi run alſo from the beginning of the epidydimis, and after ſome time they all unite into a ſingle tube; for, upon fixing a tube with mercury into the vas deferens, and cutting the epidydimis tranſverſely beyond the middle, the injection runs out from one orifice only; and upon ſeparating the coni vaſculoſi, they

all unite into one duct. This at firſt is not larger than a ſingle hair from a horſe's tail, but gradually becomes wider, as we come near to the vas deferens; and it deſcribes 20 feet at leaſt before it terminates in the vas deferens.

CCCCLV.

Thus after the ſemen is ſeparated from the arteries, it acquires its properties in a great meaſure by ſtagnation and abſorption, in paſſing through the ſeminal tubes; and we obſerve an uncommon number of lymphatic veſſicles ariſing from the teſticle.

CCCCLVI.

One would be ſurpriſed to conceive by what power the ſemen can deſcribe ſo long and intricate a courſe; and we muſt ſuppoſe that theſe tubes poſſeſs a truly muſcular or living power. We cannot obſerve the contractions, or ſee the fibres; but the reaſon of the thing, and the obſervation that paſſions have been found to occaſion ſwellings in the ſeminal ducts, lead to this ſuppoſition. In the dog kind the copulation is tedious, becauſe the veſiculæ ſeminales are wanting; ſo the ſemen is brought round in that time from the teſticle, and it muſt paſs quicker than at other times, and there muſt be a living power to convey it, the vis a tergo aſſiſting in ſome meaſure.

CCCCLVII.

By attending to the ſituation of the epidydimis,

we diſtinguiſh a ſwelling in the ducts from one in the teſticle or *chord*. The principal part of the *chord* enters upon the inner ſide, and the epidydimis is longer than the teſticle, ſo that the bottom of it can be diſtinctly felt. We likewiſe ſee that the ſlighteſt wound of the epidydimis beyond its middle may interrupt the courſe of the ſemen, ſo that a ſurgeon ought to be cautious not to puncture it in the ſmalleſt degree. Even if any ſwelling forms that can preſs upon a ſingle turn of the duct, the whole organ above will be affected; and if it begins at the lower end of the epidydimis, unleſs it is ſpeedily removed, the whole epidydimis and teſticle will be affected. But conſiderable ſwellings often remain at the beginning of it, in the coni vaſculoſi, without affecting the teſticle; becauſe, from the communication at the rete teſtis, it paſſes into the coni vaſculoſi.

CCCCLVIII.

The vas deferens runs down at the back of the bladder, then ends in the veſiculæ ſeminales, in this manner: ſuppoſe the inteſtinum cæcum, the part of it preſſed againſt each other, and that the vas deferens coming down againſt it, approaches nearer to the veſiculæ ſeminales, and is more convoluted; and add to the inteſtinum cæcum a number of inteſtinula cæca, ſeveral ſacs containing the ſemen, and add the ſame to the vas deferens, the ſurface is greatly increaſed, with a

view of adding to the qualities of the ſemen. Perhaps the proſtate gland mixes its liquors with the ſemen within the penis; but that is not ſo eſſential as the liquor in the teſtes; for in ſome claſſes of animals, as in birds, it is wanting, yet the ſtructure of the teſticle is the ſame as in man, ſo it is only of ſecondary uſe. There is a quantity of mucus diſcharged for a defence againſt the urine.

CCCCLIX.

The only thing that remains is the erection of the penis. Some have conceived that it depends upon an unuſual flow of blood made from the arteries, by their oſcillations being increaſed. The common opinion is, that it depends upon a difficult return of the blood through the veins; and if the veins are tied up, the penis is in a certain degree diſtended.

CCCCLX.

The only difficulty is to determine the means by which the ſtoppage is made, for that has been improperly explained; viz. that the vena ipſius penis runs on the pelvis, and that the muſcles preſs it; but they rather draw down the penis, and make a preſſure againſt the corpora cavernoſa. The vena penis poſſeſſes a muſcular, or contractile power, for it is reder and thicker than the other veins; and the principal plexus paſſes away from the artery in a very unuſual manner within

the levatores ani, and is expoſed to the action of theſe muſcles, which are in action at the time; and ſome degree of contraction in the coats of the veſiculæ ſeminales may aſſiſt in emptying them. The weight merely of the urine may diſpoſe to the erection of the penis, and the blood being effuſed into the cells cauſes the diſtention.

CCCCLXI.

Female Parts of Generation.

The female parts of generation have commonly received, from anatomiſts, a diviſion into external and internal, or thoſe which appear to view on the mere expoſure of the body; and thoſe, again, which are more deeply ſituated, require a ſeparation of parts, and a more minute inſpection to detect them. The former comprehends the mons veneris, the labia externa, nymphæ, and clitoris; the latter the vagina, the uterus, and its appendages.

CCCCLXII.

The mons veneris is the riſing eminence we find ſituated at the termination of the recti muſcles, or immediately above the next part, the labia externa. It is compoſed of a quantity of adipoſe ſubſtance, which forms the ſkin into a kind of tumour; and on this the firſt ſigns of puberty come to be conſpicuous. It is through this part, alſo, an inciſion is directed in thoſe caſes where a diviſion of the ſymphyſis to enlarge the pubis by the operation of Sigault is made.

CCCCLXIII.

From its inferior part, on each ſide, ariſe the labia pudendi. In their texture, they reſemble the mons veneris; and in their appearance a great variety prevail in different ſubjects. In ſome they are large and protuberant; in others, again, they are ſhort and flaccid. Before parturition, however, they are generally ſhorter and more confined than afterwards, for they become lengthened by repeated labours; and in ſome caſes alſo their fatty part decreaſing, they become harder, and loſe their ſenſibility. Their extent is moſtly from the ſymphyſis of the pubes to near the anus, a ſmall ſpace only termed the perinæum, or fourchette, intervening to form a diviſion; yet, in particular caſes, they have been found to extend to the anus itſelf. Internally, the membrane which lines them ſeems more condenſed than the external, and is furniſhed with a number of ſmall glands which excrete a ſebaceous liquor for moiſtening their ſurface. By their ſoftneſs they give no reſiſtance to the paſſage of the child when ſo far advanced during labour; and, at the ſame time, they form a ſufficient covering, by their junction, for defending from external injury the parts below.

CCCCLXIV.

On ſeparating the labia appear two ſmall fleſhy bodies of a ſimilar figure. They are termed the

nymphæ, and confist of a doubling of the internal membrane which lines the labia and the interior parts. They differ in their appearance in different women, and are of a texture very vascular, especially in their inner surface. Besides the purposes they serve in coition, their chief use seems to be to direct the flow of the urine, for they possess a muscular contraction at each time of its emission; though this is still more remarkable in some animals, as mares, in which also the labia have in some degree the same power. In girls, they discover somewhat of a corrugated appearance, and are very small; but after the age of puberty, or on the application of any stimulus to increase an afflux of their circulation, their size becomes enlarged. Hence they are fuller and more protuberant in prostitutes, and less so in modest women. This enlargement is sometimes preternatural, especially in hot climates, where an operation for their explanation, named nymphotomy, is therefore required.

CCCCLXV.

Immediately above the nymphæ, the latter being somewhat connected to its inferior part, is observable a small glandular substance. It consists chiefly of a congeries of vessels, covered by a loose skin, received from the internal membrane of the labia, termed its preputium; and this vascular part, or proper body of the clitoris,

takes its origin from the inferior part of the offa pubis, by means of two crura which unite here to form it. It has commonly been compared to the penis of the male, and in fome refpects, perhaps, refembles it. For, as it receives a more than ufual quantity of fluids above the parts defcribed, it poffeffes alfo a greater degree of turgefcence; and, from its fenfibility, as its increafe of fluid is eafily produced by the application of any ftimulus, it has become, in confequence of the latter, and by the dilatation of its veffels, frequently elongated to fuch a degree as to fhew a fimilar erection. It differs, however, from the male penis in fome particular circumftances, for it has no aperture or perforation for the tranfmiffion of any fluid, and confequently no corpora fpongiofa, and it is tied down likewife by a kind of fufpenfory ligament, as has been apparent in thofe who have been fhewn for hermophradites.

CCCCLXVI.

Between the nymphæ there appears on their feparation a hollow fpace, named the foffa navicularis, in the middle of which is obfervable a fmall prominence, or granulated point, being the orifice of the urinary paffage, or urethra, in the female. It is larger than that in the male, and admits in diameter the fize of a quill. Its whole length meafures only about 1½ inch from the bladder, which poffeffes at its neck no proftate

gland, and forms the lefs refiftance by this ftate of the parts to the paffage of calculi. By the prominence obferved in its orifice, the urethra is eafily diftinguifhed by the feel; and round it there is alfo fituated a number of mucous glands, which excrete a liquor for defending the parts from the influence of the urinary acrimony, and thefe, at times, being attacked by inflammation, acquire fuch a patulous ftate, as to equal in diameter the fize of the urethra itfelf; for which they are even fometimes in fuch inftances miftaken.

CCCCLXVII.

About two inches or lefs below the urethra, laft defcribed, by which its orifice is fometimes concealed in women who have born children, on feparating the labia appears the firft of the internal parts, or the mouth of a large hollow tube, termed the vagina, which opening is called the os externum. It forms the entrance to the more interior parts, and is the paffage through which the fœtus is tranfmitted in delivery. Anteriorly, it is connected to the bladder, which is fomewhat larger in the female, and more rounded in its fhape than in the male; and pofteriorly, to the rectum. Hence injuries happening here are continued through thefe organs, and a paffage for the urine and fæces has thus frequently taken place for life from this fituation. It confifts of three coats. 1. A mufcular, by means of which its fibres poffefs the

power of contraction, and therefore its dimensions vary at different times; and so strong is this muscular power which the vagina possesses, as frequently to throw instruments from their place when introduced for the purpose of delivery. 2*dly*, A rugous; and 3*dly*, an intermediate quantity of cellular substance. In its appearance, it is something similar to the membrane of the palate; for before parturition, or in young girls, it possesses on its internal surface a number of corrugated or wrinkled folds, termed its rugæ, which are placed in a transverse direction, in the form of an arch, so as to allow a greater enlargement of its diameter when expanded by the pressure of the fœtal head in its expulsion to delivery. It is on this account, also, we find them most numerous on its anterior side, where it lies towards the urethra, and where the greatest degree of extension for the enlargement of its limits is required. Its length varies at different periods, and in the unimpregnated state it is generally three inches, though it depends for this on the situation of the uterus. After conception, the uterus falling lower, it becomes shorter. As the uterus, however, stretches upwards, it proportionally lengthens out the vagina; and, as its orifice projects loosely into its cavity, whatever cause relaxes the vagina, occasions its falling lower. The same variety prevails also in its width. At the age of puberty it is usually

ſo ſtraight as hardly to admit a finger; and in the firſt coition, therefore, the introduction of the penis becomes difficult. When conception in ſuch circumſtances takes place, labor is on this account tedious and difficult, and a long time is neceſſary for the ſtretching of the parts. After child-bearing, however, its dilatation becomes ſo great, as eaſily to admit the whole hand; though, even in this ſtate, from its contractile nature it can accommodate itſelf to the ſize of any exciting body introduced within its cavity. The degree of this contractility has been ſuppoſed by ſome to depend on its diſtance from the period of menſtruation, by which the whole of the genital ſyſtem is relaxed, and particularly the paſſages.

CCCCLXVIII.

In its diameter, the vagina differs at different places; for at its two extremities it is more contracted than in the middle. The os externum we find ſurrounded with a muſcle whoſe fibres run in a circular direction, and ſerve, by this means, when excited into action, ſtrongly to contract it. They take their riſe from the oſſa pubis, under the ſituation of the clitoris; and, by this muſcle, in thoſe women who are advanced in life before the occurrence of pregnancy, a reſiſtance to the paſſage of the head for the ſpace of ſome hours is formed. In youth, alſo, in the firſt labour it becomes ſpaſmodically conſtricted, and poſſeſſes

the ſame effect. On the internal ſurface of the vagina, beſides the rugæ mentioned, we obſerve every where a number of ſmall glands of the ſame nature with thoſe round the orifice of the urethra, formerly deſcribed. They excrete a mucus moſt conſpicuous in the time of coition and during labour, by which the effects of the ſtimulus attending both theſe operations is obviated, and the hazard of inflammation avoided. Its too copious diſcharge occurs alſo at times, and forms then a diſeaſe.

CCCCLXIX.

But, beſides the muſcle ſerving to contract the os externum, and which is not ſo conſpicuous, requiring a pretty accurate diſſection, four ſmall glandular bodies are obſervable of a ſimilunar ſhape, though ſomewhat different with reſpect to their particular figure: in different objects they are generally very regular in their appearance, termed the carunculæ myrtiformes. Many diſputes have prevailed among authors with regard to their nature and uſes. They ſeem partly much of the ſame kind with the nymphæ, being certain rugoſities of the ſkin to allow the ſtretching of the parts when required. Though pretty diſtinct in the only part of life before parturition, they generally diſappear like the rugæ of the vagina after childbed, which further confirms our opinion of their uſe. Many, however, have ſuppoſed their ſtruc-

ture glandular; and, if ſo, the particular offices they may ſerve by their excretion we are ſtill at a loſs to determine.

CCCCLXX.

Inſtead of them, or as ſome affirm, previous to their appearance in the infantine ſtate, we find a thin membrane in the form of a creſcent extended partly over the orifice of the vagina, named the hymen. No ſubject has, perhaps, been more diſputed by anatomiſts than the exiſtence of this part, and we have the authority of the late Dr. Hunter for declaring that it is never abſent in a female at birth. From its texture, however, it is eaſily ruptured by accidental cauſes in childhood, and then aſſumes the appearance of the carunculæ myrtiformes. In ſome caſes it has been known to continue, however, entire to the age of puberty, and to extend further over the os externum than uſual. In ſuch caſes an inciſion has been found neceſſary for its removal.

CCCCLXXI.

The parts of the genital ſyſtem, as yet examined, may be conſidered only with regard to generation in a ſecondary view; and we are next, therefore, in our examination directed to thoſe organs which are more interiorly ſituated, and with which generation itſelf is more immediately connected.

CCCCLXXII.

The firſt of theſe, at the extremity of the

vagina, is the uterus. It is ſituated in the middle of the pelvis, between the bladder on its anterior part, and the rectum poſteriorly; and hence, in conſequence of diſeaſe, a communication with both theſe, as in the caſe of the vagina before mentioned, may be occaſionally produced. In its natural ſtate its figure has been compared to a pear flattened on its ſides, or to a ſmall powder flaſk; and by this flatneſs on its ſides, which is moſt remarkable poſteriorly, where it joins the rectum, it comes to be more cloſely retained in its ſituation, or applied to the neighbouring parts. Anatomiſts have commonly deſcribed it under three diviſions, or diſtinct parts; the ſuperior and largeſt one bounded by the Fallopian tubes, being termed its fundus; next to this its body, and its inferior portion ending in its orifice, named the cervix or collum. At both its extremities the uterus is a little convex, and at its fundus this convexity is increaſed in the pregnant ſtate, by which, when diſtended, and riſing above the pelvis, as we ſhall afterwards find, it forms ſomething of an arch, and becomes more capable of ſupporting the incumbent viſcera. Its ſize has been commonly ſuppoſed to meaſure longitudinally, beginning from its fundus to its orifice, three inches; and tranſverſely, from two to one, according to the diſtance at which we take it from the fundus. After the age of 14, or the

appearance of the menſes, it does not ſeem to increaſe, and in this it differs from the other organs of the body. Some ſmall difference, however, may be perceived at each ſucceſſive period of this diſcharge, for before the evacuation, the fundus may ſometimes be felt in thin women by the hand applied on the abdomen, tenſe and more than uſually diſtended; and thoſe alſo, who are ſubject to profuſe menſtruation, from the greater dilitation of its veſſels, have the uterus conſiderably more enlarged than the others. Some authors deny that the uterus, internally, before impregnation poſſeſſes any ſenſible cavity. It is, indeed, ſmall, but when cut open, will be found very apparent. Its figure is triangular, two angles of which ariſe from the orifices of the Fallopian tubes, and the third from the os tincæ. Through its whole ſubſtance the uterus ſeems, on diſſection, to poſſeſs a very compact nature, which has been compared, from the whiteneſs of its texture in the virgin ſtate, to the corpora ſpongioſa penis. Externally, it receives a covering from the peritonæum, and this covering forms the means by which it is connected to the Fallopian tubes and ovaria, while internally, again, the fine membrane lining the vagina, is continued over its ſurface, and hence it poſſeſſes here the ſame glandular texture with that of the vagina deſcribed. Before pregnancy, it is even diſtin-

guiſhed by the ſame rugous appearance; and theſe rugæ are moſt numerous at its neck, where, after parturition, ſome traces of them in young ſubjects ſtill remain. In the neck, alſo, are conſpicuous a number of ſmall lacunæ, or ducts, which pour out a mucus for lubricating the adjacent parts of its cavity, and which forms a cement, cloſing the orifice of the uterus during geſtation. From our experience of its contractile power in labour, by the expulſion of the child we are naturally led to ſuppoſe the uterus a muſcular organ. Its muſcular fibres, however, till after delivery, it is difficult to diſtinguiſh, and then they appear to be matted together irregularly, ſo that there is no proper foundation for the muſculus orbicularis painted by Ruyſch. Theſe muſcular fibres, when perceptible, are moſt ſo on its external ſurface, which is leſs firm than the internal, and the latter again than the cervix. In proportion to its ſize, the uterus receives a greater quantity of blood than any other organ, the heart and lungs excepted, and its veſſels are therefore, even in the natural ſtate, proportionally large. They are derived from the hypogaſtrics and ſpermatics, thoſe from the latter being ſmalleſt, and are ſpread in a tortuous convoluted manner through its ſubſtance. The veins, however, are ſtill larger than the arteries, and are derived alſo from the ſame ſource. They have no valves, and by this means

the motion of their fluids is rendered ſlower, and a degree of ſtagnation favoured, while frequently anaſtomoſing in particular places, they acquire in this way a remarkable ſize, and are therefore diſtinguiſhed in pregnancy by the name of ſinuſes.

CCCCLXXIII.

The nerves of the uterus are derived from branches of the *6th* pair, or that one which ſupplies the ſtomach and ſome of the other viſcera. It receives them likewiſe from thoſe of the ſacrum, and hence the remarkable ſympathy, in caſes of diſeaſe, it communicates to all theſe parts. The ſituation of the uterus, we mentioned as in the middle of the pelvis, above which it is not to be felt in the unimpregnated ſtate; for a line drawn from the top of the ſacrum to the pelvis, will hardly fall within its fundus: but before the age of puberty it is generally found higher, being, in conſequence of the preſſure of the inteſtines and its attachment with the bladder of urine, made gradually to ſink lower; and after conception it comes again to be raiſed, ſo as, at the end of geſtation, to reach as high as the pit of the ſtomach. It is not placed perpendicularly, but a little to one ſide, and that commonly the left, which we find very apparent in pregnancy. The neck of the uterus projects, as we obſerved, into the vagina, and that in young ſubjects, in

the form of a nipple or ſmall tubercle. After parturition it becomes in its figure more eliptic; and in thoſe who have born many children, the finger may be introduced within its orifice for a little way. We find a vaſt difference between the ſtructure of the uterus in animals, when compared with that of the human ſubject. In them it is ſeparated into certain diviſions, or cells, for the reception of each fœtus, not poſſeſſing a uniform cavity like that deſcribed, and theſe cells have not the ſmalleſt connection. Its internal ſubſtance is likewiſe unequal at particular places, by certain glandular bodies growing from its ſubſtance, named cottilydons, and which ſerve, by being connected with the fœtus, to nouriſh it in the pregnant ſtate. The uterus is preſerved in its ſituation by four ligamentous expanſions, or productions from its external covering. The firſt are named the ligamenta lata, and are connected to the bones of the ilium, ſo as to retain it in its proper length; and the latter, running off from the former in the form of cylindrical chords, from their figure are named the rotunda, and paſs through the groin, in the ſame place as the ſpermatics in men, confining it before. Both are leſſened in their ſize by their extenſion during pregnancy, and eſpecially the round ones. Their ſituation is alſo ſomewhat altered, during the ſame period; for, by the enlargement of the

fundus, the broad ones are placed in a ſituation much below the middle of the uterus, which they formerly poſſeſſed; while the uterus itſelf is leſs fixed, the greater part of its body floating looſe in the abdomen; and an inverſion of it, on this account, is more readily endangered after delivery. The round ones have, by many, been ſuppoſed to act in a certain degree as muſcles to the uterus, by drawing the fundus a little downwards, and conſequently lowering its orifice for the more eaſy admiſſion of the ſemen in coition, and the deſcent of the child's head in labour. In the latter caſe, it ſeems to prevail in a firſt labour, when the fundus riſes higher than afterwards, and where, of courſe, they are put more upon the ſtretch. The ligamenta lata have no remarkable circumſtances to diſtinguiſh them, except from forming alſo a covering to the Fallopian tubes and ovaria. Where that part of the uterus, named its fundus, ends, are obſervable two ſmall orifices, fit only to receive the ſize of a hog's briſtle, and which enlarge in width, in the manner of a trumpet, as the cavity of their paſſage aſcends, terminating at laſt in a ſort of ragged or fringed appearance, which is looſe and floating, named the morſus diaboli, and is ſomewhat ſimilar in its figure to the foot of a frog when expanded. Theſe paſſages are termed, from the name of their diſcoverer, the Fallopian tubes; and merit our

particular attention, as on their ſtate, along with that of the ovaria, the occurrence of conception has been ſuppoſed to depend. Their cavity proceeds not in a ſtraight, but convoluted direction, meaſuring near three inches in length, and their texture ſeems evidently of a muſcular nature, though its fibres, from their minuteneſs, it is difficult to unravel. They are connected to the ovaria, or two oblong bodies, by means of their covering or external coat, and in this connection they ſhow ſome reſemblance to that of the inteſtines with the meſentery.

CCCCLXXIV.

The ovaria are two oblong ſoft bodies, ſituated beſide the Fallopian tubes, and ſo named by phyſiologiſts from their containing, on diſſection, a number of ſmall veſicles, or limpid bags. They have been commonly compared in their appearance to the teſticles, and ſuppoſed as deſigned for a ſimilar function, and hence is derived the opinion of the ſemen in the female. Their figure is ſomewhat different in different women. In their ſize, however, they are pretty much the ſame, though after childbearing they turn more flaccid and decayed; and their ſtate has been ſuppoſed in a great meaſure to influence the other parts of the genital ſyſtem. Their dimenſions are commonly rated at 1 inch in length, $\frac{1}{2}$ in breadth, $\frac{1}{4}$ in thickneſs, and their texture ſeems very vaſcular, while their ſur-

face externally is very unequal. The number of ova contained in them is very various. Theſe ova form the rudiments of the future fœtus, an opinion fully eſtabliſhed by the experiments of many modern phyſiologiſts.

CCCCLXXV.

In reviewing the genital parts of the female, we obſerve no holes naturally leading out from the ovarium, and yet afterwards it will appear, beyond all doubt, that the ova diſcharge themſelves upon the ſurface; for the chord which ties the ovarium to the uterus is ſolid, and is not, as was ſuppoſed, a tube ſerving for conveyance; it is merely a ligament; and the only paſſage we find between the ovarium and uterus, is through the tube named uterine, or, after its discoverer inventor, Fallopian. The mouth of this is wide, more than ſufficient to contain an entire veſicle from the ovarium; but then, as it approaches the uterus, it becomes much ſmaller, only admitting a large briſtle. Around the mouth, which opens into the cavity of the pelvis, or abdomen, we find a number of fimbriæ, or fringes; and although theſe ſerve one uniform purpoſe of laying hold of the ovarium, as we lay hold of any ſubſtance by the hand, yet it is found that the fimbriæ vary in their ſhape in every ſubject. Their ſtructure, and that of the reſt of the tube, is, without all doubt, muſcular; we diſtinguiſh red fibres, that are laid

parallel to one another, we have the ſame evidence of muſcular ſtructure here that we can give in deſcribing the parts of the alimentary canal. The uterine tube terminates at the corner of the uterus, ſerving to convey the rudiments of the fœtus into it. We avoid determining the appearance of the rudiments more exactly; nor do we ſay that one entire ovum paſſes, but merely a ſomewhat is conveyed.

CCCCLXXVI.

The uterus is ſpongy in its inner part, and is full of veſſels with orifices, from which blood is diſcharged into the cavity of the uterus at every menſtrual period. The cavity of the uterus becomes gradually of a roundiſh ſhape, and forms the cervix uteri, and this part we have ſeen unequal, with a number of rugæ or valves, and in theſe interſtices a quantity of ſlime is depoſited, and the texture is different from the reſt of the body of the uterus. The end of the cervix uteri, or os tincæ, is directed backwards, and reſts againſt the vagina, and it is kept in this ſituation by the manner in which the uterus and its appendices is ſupported by the ligamenta lata, which are doublings of the peritonæum, the ſame as the meſentery is. To ſhew the advantage of this ſituation, it may be remarked, that the ligamentum latum, by the diſtenſion of the uterus, is gradually leſſened in its breadth, till in the laſt

months of pregnancy we ſcarcely can ſhow it; ſo that it does not merely ſupport the uterus in the unimpregnated ſtate, but is ſo formed, that the outer covering may yield in proportion to its growth, and the lamellæ are gradually ſeparated from each other to keep the uterus more ſteadily in its place. We alſo find the ligamenta rotunda, which ſerve to balance the uterus, to keep it from being toſſed from ſide to ſide, and they alſo drag the body of the uterus forwards, and therefore ſerve to keep the os tincæ more in the direction backwards, and thus the uterus is turned more backwards in the time of pregnancy than it is at other times, when there is more occaſion for preventing its falling down into the vagina. The vagina in preſſing downwards, is likewiſe not a ſtraight direction, but reſembling the inteſtinum rectum, at the lower part turns forwards, and that ſtill in a greater degree. Within the vagina we find organs for ſecreting mucus, and at the external part, cells that are capable of diſtenſion, containing the corpora cavernoſa. On the manner of their diſtenſion it may be ſaid that the external parts, by their ſenſibility, ſerve to excite theſe motions of the internal, which are neceſſary for conception, particularly of the uterine tubes towards the ovaria, and afterwards in promoting the ſomewhat into the cavity of the uterus. From attending to the connection and ſituation of theſe parts,

we can underſtand ſeveral things that happen in practice.

CCCCLXXVII.

Firſt, without entering into the reaſon of it, it is a fact that neighbouring parts ſympathize or ſuffer together. Thus, if the middle finger has been bruiſed, and inflames, the one next it more readily partakes of the inflammation than a more diſtant part. So in practice we find that an irritation being applied to the bladder, uterus, or rectum, the affection is propagated from the one to the other. Thus the menſtrual flux can be retarded by an irritation begun in the bladder or rectum, and the bladder will ſympathize, and a ſtrangury be occaſioned by an affection of the uterus or vagina. We can alſo conceive that the mechanical connection of the parts muſt have a very conſiderable effect, for the bottom of the bladder is connected cloſely to the vagina, not only the urethra being connected, but likewiſe the body of the bladder, and that higher than the mouth of the urethra, and we may make an application of this in ſeveral caſes. Thus, if there ſhould be a prolapſus uteri into the vagina, it muſt neceſſarily drag along with it the under and back part of the bladder, and likewiſe affect the inteſtinum rectum, though there is here a leſs connection, from mere cellular ſubſtance being interpoſed. Remarkable caſes have occurred where

the prolapſus uteri has been to ſuch a degree, that the uterus has fallen without the body, the os tincæ forming the lowermoſt part of a tumour reaching between the thighs, and the back of the bladder has been dragged along with it, ſo as to invert the urethra, ſo that the urine has had to aſcend in order to get out, and the bladder been ſo much diſtended, that it reached higher than the umbilicus, and was capable of containing ſix or eight parts of liquor, with which the coats were much thickened. The bladder may be ſuppoſed to affect the uterus; ſo, if a ſtone in the bladder proves an irritation as frequently to cauſe the prolapſus ani, which is by no means uncommon, it may have a ſimilar effect upon the uterus and vagina.

CCCCLXXVIII.

The mere diſtenſion of the parts here preſerving their natural place muſt have a very conſiderable effect, hence it is a rule laid down by writers in midwifery to empty the bladder and rectum before delivery. And we can explain why in one ſtage of pregnancy a woman will not be able to retain the uſual quantity of water, from the uterus preſſ-ing upon the bladder: but in another ſituation the weight of the uterus bearing down upon the urethra, and compreſſing it againſt the os pubis, there may be a neceſſity for drawing off the water with a catheter, or a coſtiveneſs may be induced from the ſame cauſe. We alſo ſee the danger

there may be of fiſtulæ forming between the bladder and vagina in conſequence of a violent inflammation from a laborious delivery, &c. Many examples occur where the urine has made its way through at the cervix of the bladder into the vagina, and it is found impracticable to cure the patients by any operation. From other cauſes, as in cancerous caſes, we find alſo eroſions and communications between the vagina and inteſtinum rectum.

CCCCLXXIX.

If there were a neceſſity for making a large opening into the cavity of the uterus for extracting a child, the danger of that would be conſiderable, from the whole body of the uterus being covered with the peritonæum. If water were collected in order to avoid this circumſtance, we would attempt to make the diſcharge by making a puncture through the cervix uteri. The ovaria are frequently the ſeat of dropſical complaints, and the water is, no doubt, contained in the natural ova, which are ſometimes conſiderably enlarged, to the bulk of an egg; and if theſe are ſmall and moveable, we cannot let out the water without the moſt manifeſt danger; and we can only attempt it when, by preſſing againſt the containing parts, they cauſe an inflammation and adheſion.

CCCCLXXX.

Next, is ſeen the ureter going into the bladder between it and the vagina; and it is of uſe to attend to this, for caſes have occurred, where a ſtone has deſcended as far as the bladder from the kidney, but ſticking in the ureter, ſtopped the flow of the urine, and killed the patient. Now, if we can judge this to be the complaint, we may feel with the finger, and we will be able to perceive the ſtone through the coat of the ureter; and, perhaps, by the finger, or an inſtrument, we may get it back into the bladder; or, it is poſſible to make an inciſion without any danger, but the opening remaining fiſtulous into the vagina, and this might not even continue. Or, if a ſtone lies within the body of the bladder, we can not only perform the high operation with more ſafety than in the male, the bladder even when moderately filled riſing a good way above the os pubis, from the greater capacity of the pelvis; but we can cut from the vagina into the bladder without meeting with any veſſels, or nerves, of conſiderable moment. Not that this is the beſt mode of operation, but we only point out the poſſibility of it. But it may become a neceſſary operation, where a ſtone lodges at the bottom of the bladder, has irritated the coat, and begun an ulceration, making its

way into the vagina. If, in the male, we prefer the lateral operation to any other, there is further reafon for preferring it here, where there is wanting the proftate glands and veficulæ feminales. Likewife we can, as in the male, make the puncture into the bladder between the crus of clitoris, or fide of the vagina; or it may be done directly from the vagina, paffing an inftrument at pleafure near to, or further from, the neck of the bladder.

CCCCLXXXI.

The defcription of the gravid uterus, and the changes induced by conception, are detailed in the Clinical Guide, Vol. III. Midwifery.

CCCCLXXXII.

Chemical Analyfis of the Secretion of the Parts of Generation.

The mucus of the urethra differs in no refpect from the mucus elfewhere, and under irritation it is increafed in quantity, and changed in confiftence in a confiderable degree.

The fecretion of the glans penis is of a febaceous confiftence, and it poffeffes a peculiar odor, the organ of it being lined by fome odoriferous glands; and, like the other fecretions, it is confiderably increafed under irritation, and when a neceffity exifts for its ufe.

The tunica vaginalis of the tefticle poffeffes an aqueous exhalation to admit the free motion of the organ, which is often confiderably increafed under difeafe.

The proſtate gland ſecretes a lacteſcent juice, which being emitted always along with the ſemen, muſt be neceſſary to the perfection of that fluid.

But the moſt important ſecretion of theſe parts is the ſemen, which is alſo the moſt highly elaborated of any in the body. In taſte, it is fatuous and acrid. In conſiſtence, it varies according to the progreſs of its courſe, being thinner in the teſticles, and viſcid, denſe, and pellucid in the veſiculæ ſeminales; but debility and relaxation produce a change in its quality. In colour, alſo, it varies a little in different parts of its progreſs, being of a deeper hue in the veſicles than in the teſticles.

Its conſtituent principles are;

1. Water, 90 parts.

2. Animal mucilage, 6 parts.

3. Phoſphate of lime, and muriate of ſoda, each one part.

4. Pure ſoda, 3 parts.

5. An animalcular appearance; and,

6. An odorous principle, or aura ſeminis.

It changes violets green. When freſh, it is inſoluble in water, but afterwards combines eaſily with it. It is at firſt opaque and conſiſtent, but in a few hours becomes clear and pellucid, and in a few days depoſits foliated cryſtals of phoſphate of lime. Its uſes and importance in the ſyſtem are well known.

Chemical Analyſis of the Secretions of the Female Parts.

The unctuous fluid of the inner ſurface of the labia pudendi is of a mucous oily conſiſtence, of a yellowiſh colour, and peculiar offenſive ſmell. It conſiſts of an

oily mucus, mixed with a peculiar odorous principle, which probably ſtimulates to venery.

The mucus of the vagina is of a viſcous nature, and moſt abundant towards the end of pregnancy, and in parturition.

The excretion of the venereal orgaſm is a whitiſh mucus, ſomewhat different from the common ſecretion of the vagina. Its quantity is very great in the ſallacious.

The uterine ſecretion, or ſerous diſcharge, is in virgins turbid and whitiſh, in children always ſo, and in pregnant women it is ſometimes lacteſcent. Its quantity varies at different times.

The mucus of the uterine cervix is very thick during pregnancy, and ſometimes of a reddiſh colour.

The liquor of the ovarium appears to be albuminous, coagulable by alcohol and fire, and ductile into white threads.

The menſtrual and lacteal diſcharges differ nothing from common blood, already examined.

Anatomical Preparation of the Penis.

To make an injection, an adult penis is preferred, which ſhould be removed from the body for the greater eaſe of the proceſs. The knife, in doing it, being carried cloſe to the pelvis, ſo as to avoid wounding the crura, and carried towards the bladder ſo as to ſeparate it by a tranſverſe inciſion juſt before the proſtate. For this purpoſe a ſection of the ſcrotum ſhould be made to allow its complete removal. The blood in the corpora cavernoſa is then to be waſhed out by firſt fixing a middle ſized injection pipe in one of the crura through

a ſmall inciſion purpoſely made, and then injecting warm water afterwards, poured out and repeated ſo long as it ſhews a bloody tinge. The orifice of the large vein on the back of the penis is then to be found in the groove formed by its ſeptum, and a probe introduced into it as far as the glans, in order to break down its valves, which would obſtruct the progreſs of the injection. A pipe is then to be fixed in it, and warm water injected to clear it from grumous blood, and again preſt out. Let it then be prepared for injection by immerſing it for an hour in warm water, and the corpora cavernoſa are then to be filled with coarſe yellow injection, and the vena magna, glans, and ſpongy body, with red. The teguments being afterwards diſſected from it, the preparation is to be dried and varniſhed, or preſerved in ſpirits of wine.

Anatomical Preparation of the Teſticles.

The teſticles are to be removed from the body, and the ſpermatic cord is to be ſeparated as high as poſſible without wounding it. The artery ſhould be filled with fine and coarſe red injection, and the vein with coarſe yellow. The vas deferens ſhould be always filled with quickſilver; for, from its length and ſmallneſs, it cannot be filled with any other injection, and in doing it conſiderable time is required from its convolutions. It ſhould remain for ſome time under water in the injecting tube, that the injection may paſs as far as poſſible by its own weight, and the injection of this part ſhould follow that of the other veſſels. The ends of all the veſſels are then to be tied, and next the ſurrounding extraneous ſubſtance diſſected away. The preparation

is then to be laid in water for ſome days to extract the blood, and brighten its colour, after which it is to be ſuſpended in the air till the parts dry, and then be preſerved in oil of turpentine. In making this preparation, all the veſſels ſhould be previouſly well cleared from blood.

Preparation of the Internal Structure of the Penis.

Where the internal ſtructure of the penis is wiſhed to be ſhewn, its arteries are firſt to be injected by coarſe red, fixing the pipe for this purpoſe on each ſide in the internal pudendal artery, on the inner ſide of the iſchium. The penis is then to be removed, and injected as already directed, but with quickſilver entirely. It is then to be macerated in water till the cuticle peels off, and ſuſpended in the air till thoroughly dried. With a knife, two lateral portions are then to be removed from the glans to the crura, which will lay open its internal parts. Two lateral pieces are alſo to be removed from the glans. Theſe openings giving an exit to the quickſilver, will better ſhew the internal ſtructure. Immerſed in oil of turpentine, the preparation will become tranſparent, and exhibit the ramifications of the veſſels through the corpora cavernoſa.

Corroded Preparation of the Penis.

This preparation is injected, as directed in the firſt. When finiſhed, the part is to be put in the muriatic acid ſolution till the parts are fully deſtroyed. When removed from the acid, it is to be waſhed as other corroſions, and caution uſed not to break any of the vaſcular branches.

CCCCLXXXIII.

Circulation of the Pelvis and the Lower Extremity.

Having examined the genital fyftem in both fexes, it remains to trace the circulation and nerves of the pelvis, from thence proceeding to the lower extremities.

CCCCLXXXIV.

The lumbar arteries, four in number, on each fide arife in pairs from the back of the abdominal aorta, and refemble the intercoftals in this refpect as they arife in the thorax. They run over the fore part of the lumbar vertebræ, and, defcending, they give branches to the fpine and fpinal marrow; and, being difperfed upon the lum[illegible] mufcles, they alfo furnifh branches to th[illegible]ments. Next, the facral artery, runnin[illegible] the middle of this bone, gives circu[illegible] bones, membranes, and back part of the rectum.

CCCCLXXXV.

The common iliacs arife from a divifion of the aorta at the *4th* lumbar vertebra. They are of equal fize, and at the laft vertebra of the loins they each divide into two branches, an anterior and pofterior one, or the external and internal iliac artery.

CCCCLXXXVI.

The external iliac, or continuation of the common trunk, defcends along the brim of the pelvis, takes a curved direction by the fide of the pfoas

muscle, and passing behind Poupart's ligament, goes to form the femoral artery. Within the abdomen it sends off two branches, the epigastric and circumflex of the ilium.

CCCCLXXXVII.

The internal iliac is chiefly distributed on the pelvis, and gives branches to all the parts contained within it, and which branches chiefly take their names from the parts they supply, and are very numerous. Thus they give the chief branches to the bladder and penis, and also to the uterus and genital parts of females.

CCCCLXXXVIII.

The circulation of the lower extremity again begins with the crural or femoral artery, which, about two fingers' breadth below Poupart's ligament, divides, like the common iliac, into an anterior and posterior branch, the former continuing, as the proper femoral artery; the latter, being termed the profunda femoris, which sends off branches to all the adjacent parts in the progress of its descent. The femoral artery again passes between the triceps muscle and the bone, to which it keeps close till it reaches the ham, and is there termed the popliteal artery. Passing between the condyles of the os femoris, it gives off several branches to the joint, and next to the upper part of the leg; then descending, it gives off to the outer edge of the popliteus two large arteries, the

tibialis antica and poftica, the former fupplying the fore, the latter the pofterior part of the leg. Thefe tibial arteries, in their progrefs, give off numerous branches. At the ankle they fend off the principal plantar branches, and thefe again fubdivide into the interoffeous and digital arteries. Thefe arteries of the foot freely communicate with each other and form anaftomofes, fo as to preferve a full and free circulation of thefe parts.

CCCCLXXXIX.

The veins of the inferior extremity confift of a fubcutaneous and deep fet. The former confift of two principal trunks, the faphenæ; the latter are more numerous, and correfpond to the arteries in their courfe and names. They all end in the iliacæ communes, which unite to form the inferior cava, which exceeds in fize that of the fuperior, and receives, at its beginning, the facral and lumbar veins, which in the left fide pafs behind the trunk of the aorta.

CCCCXC.

Nerves of the Pelvis and the Lower Extremity.

From the nerves formerly defcribed of the chylopoetic vifcera, we defcend to the hypogaftric plexus, which is connected to the great fympathetic and facral nerves, and fends fmall twigs to the bladder, rectum, and fpermatic veffels in the male; and to the fame parts, and the uterus and vagina in the female. The great fympathetic

runs along with the lumbar and ſacral nerves, and ſupplies the loins, pelvis, and inferior extremity.

CCCCXCI.

In doing this, the ſympathetic nerve from the lumbar vertebræ deſcends into the pelvis, and paſſes over the anterior ſurface of the os ſacrum. At the lower part of the pelvis it becomes ſmaller, finiſhing its courſe on the coccyx. In the loins and pelvis it forms ganglia, which, in the latter, are connected with the ſacral nerves.

CCCCXCII.

The five lumbar nerves in their deſcent form a plexus, which is ſituated behind the pſoas muſcle, and termed the lumbar plexus. In their farther progreſs theſe nerves unite, and form a trunk of great ſize, named the crural, which ſends down branches to every part of the leg.

CCCCXCIII.

The ſacral nerves conſiſt of ſmall poſterior, and large anterior trunks. They go out of the holes in the forepart of the ſacrum, and unite with each other, and with branches of the ſympathetic. They afterwards in part join with ſome of the lumbars, and form a plexus which gives origin to the ſciatic nerve, the largeſt in the body. The roots of the ſciatic form the faſciculi, from whence ariſes the pudic nerve. The ſciatic nerve, after leaving the pelvis, deſcends in the back part of

the thigh to the ham, where it receives the name of the popliteal nerve, and in this courſe it gives off a great number of branches. A little above the bending of the knee it is divided into the tibial and fibular nerve, which poſſeſs alſo their ſubdiviſions. In the end, the tibial nerve divides into the external and internal plantar of the foot, which are diſtributed as the principal ſupply of the ſole and toes.

CCCCXCIV.

We now come to conſider the vaſcular diſtribution of the inferior extremities in review. The trunk of the aorta within the abdomen is cloſe to the ſpine, hence the ſwelling and ſtroke of it are entirely outwards; ſo that in many perſons the containing parts of the abdomen being preſſed backwards, we can diſtinguiſh the ſtroke; and ſometimes perſons have been ſuppoſed to labour under aneuriſm of the aorta from this circumſtance.

CCCCXCV.

About the fourth lumbar vertebra the aorta divides into two equal branches, for there is nothing found in the diſtribution of the veſſels which ſhould determine us to prefer one extremity to the other. And, in fact, if by any accident the right arm comes to be diſabled, perſons very readily learn to give the left leg the preference in performing the motions; and this

may ferve to confirm the reafon of the preference mankind in general give to the right arm, that the particular divifion of the aorta has a fenfible effect. The aorta runs outwards not in a direct line to the thigh, but in order to avoid the cavity of the pelvis a confiderable angle is formed, and the blood rufhes againft the divifion with confiderable force; and this may explain what we find, that, next after the beginning of the aorta from the heart, the divifion of it at the iliacs is moft fubject to difeafe.

CCCCXCVI.

Here we can judge of the proportion which branches bear to the trunk; and from this divifion we would fuppofe that the common computation made is nearly juft, that the branches put together exceed the trunk by one half.

CCCCXCVII.

The principal artery of the uterus is the hypogaftric, and from its fituation an experiment has been propofed, to make preffure on the femoral artery, in order to promote the menftrual difcharge; and though we are not to expect fo much as has been imagined from this, becaufe we do not find that a fudden increafe of the force of the blood always caufes the menftrual difcharge; yet that may be fuppofed to concur, whilft other circumftances are favourable, and therefore in many cafes the experiment ought to be purfued.

It is evident that the preſſure upon this artery muſt increaſe the momentum of the blood in the uterus, and in many caſes at leaſt promote the diſcharge.

CCCCXCVIII.

In both ſexes we ſee a branch ſpent upon the middle of the inteſtinum rectum, whilſt other branches are furniſhed to the extremity of the rectum. Now it is evident, that the common account of the cauſe and frequency of hæmorrhoids is by no means juſt, that the blood returns difficultly through the vena portarum, for their moſt common ſeat is ſupplied from the aorta, and the blood is returned by the vena cava; ſo we muſt find ſome other cauſe. In a few caſes, the diſcharge, perhaps, is made higher; and the difficulty of the return through the vena portarum may render the diſcharge more copious.

CCCCXCIX.

A branch deſcends from the internal to the external organs of generation, and the ſituation of the artery with reſpect to its vein is particular, the elevator coming in between them; hence the erection of the penis is in a great meaſure owing to the action of that muſcle, and the ſame applies to the female.

D.

The laſt branch of the internal iliac ſupplies the muſculi glutæi. An aneuriſm is ſometimes formed

under the glutæus maximus, occupying the back of the great trochanter. An aneurifm may remain long in the fame fituation, and therefore we fhould not be too rafh in forming a prognofis.

DI.

The external artery is lodged at the fide of the pfoas mufcle, protected as much as poffible from the preffure of the bowels in the pelvis and abdomen; and the artery here runs external to the vein, perhaps becaufe the artery fuffers lefs from preffure than the vein would have done. We fometimes fee, from the effect of the preffure, œdematous fwellings produced in the legs.

DII.

The artery at length gets behind the tendon of the oblique, and fends off two confiderable branches, the circumflex artery, and the epigaftric artery. We find the latter covered by the inguinal glands, to which it is tied by cellular fubftance; and, therefore, in treating thefe by operation, we fhould be particularly cautious; even cauftic laid along, might go fo deep as to reach the coats of the artery; and therefore it is fafeft to treat buboes, &c. by incifion.

DIII.

At this place the artery is fituated directly over the head of the thigh bone, covering the round ball. Hence furgeons have been deterred from making incifions into the cavity of the joint to

discharge matter, &c.; and it is certain that an incision cannot be made into a joint or ligament without a considerable degree of danger, yet the danger from the effect the matter has upon the ligaments, inflaming them, producing hectic symptoms, &c.: or, from its making its way into the pelvis through the socket, &c. may be greater, especially as we can make the incision without wounding the arteries or nerves, as the capsular ligament of the thigh does not merely include the ball, but takes in the neck of the thigh bone; so we can make the incision at the outside of the beginning of the sartorius muscle; and of the tendon of the iliacus internus, at the most depending place, where the matter will be most readily discharged. Lower than this, it gives off its circumflex branches which communicate with the internal iliacus; and if, by any accident, the femoral artery should be wounded, we may not only save the life, but the limb, and are not to think of amputating at the top of the thigh, which, from the quantity of blood lost, the number of nerves, &c. is attended with the utmost danger; so we must attempt to tie the artery, in the hopes that the branches may convey as much blood as is necessary; and going lower, the prospect of success continually increases, because of the more numerous anastomoses.

DIV.

As the artery paſſes downwards to the ham, it lies near to the bone, ſo we can ſtop the blood with a tourniquet, by preſſing the femoral artery againſt the bone.

DV.

We attend to the exact ſituation of the arteries, in order to find them after an amputation. There is no difficulty of finding the trunk of the femoral one in the thigh; but in the leg, two of the arteries are more connected to membranes; the anterior tibial is connected to the interoſſeous membrane in ſuch a manner, that it requires attention to detach it. The difficulty of raiſing this is ſuch, that the ſurgeon ſometimes ties the thread round the bone; but that includes the perioſtæum, and ſeveral threads of the muſcles. And as the nerves are divided here minutely, ſome of the membranes may be taken in.

DVI.

When we trace back the blood from the foot, we obſerve the ſame general ſtructure as in the arm; only the deep-ſeated veins are larger, and the outer ones of courſe ſmaller. From the greater activity of the ſuperior extremity performing more varied motions, ſo the blood is more in danger of being ſtopped, and the deep veins do not divide into ſo many branches; but they are larger, and therefore a ſurgeon in performing

amputation will be under the neceſſity of tying the veins, as well as the arteries, if the amputation is immediately above a pair of valves, the neighbouring veins pouring in their blood.

DVII.

The laſt general remark upon the blood veſſels here is, that the coats, both of the arteries and veins, are remarkably thicker than in any other place of the body; and from this we may conclude, that the force of the heart is not ſo very immenſe as many phyſiologiſts have ſuppoſed, otherwiſe the addition of a few feet of column would not have made ſo great a difference. We ſee the effect of the column in dropſical ſwellings more readily appearing in the feet; and we can account for that, without ſuppoſing that the branches of the red veins abſorb, for there is a greater preſſure made upon the lateral branches of the arteries, and the ſwelling may be owing, not to a want of abſorption, but to an increaſed exhalation; and taking in the lymphatic ſyſtem, we ſee that the abſorbed liquors return more difficultly.

DVIII.

But notwithſtanding of the increaſe of the thickneſs of the coats, the veins of the lower extremities are more ſubject to varix than the upper, for they are ſubject to more unequal preſſure; they are acted upon by many muſcles before

the blood returns to the heart, and the preſſure made by the contents of the abdomen is very unequal, even a preſſure made by dreſs will have the ſame effect as a diſtention of the bowels in the abdomen.

DIX.

To conclude our account of the veſſels and nerves of the inferior extremities, the anterior branches of the nerves are by much the largeſt, particularly in the trunk of the body: the muſcles are ſupplied by a number of minute branches, none of which are of ſuch conſequences as to prevent a ſurgical operation: and every one of the long muſcles is ſupplied from a number of nerves; and, inſtead of flexion being performed by one nerve, and extenſion by means of a different nerve, we ſee them ſupplied by the ſame nerve, and a ſingle flexor or extenſor ſupplied from a number of roots.

DX.

When a ſtone deſcends through the ureter, croſſing obliquely the anterior branches of the nerves in the loins, the cremaſter muſcle is thrown into action, and drawn upwards. We are not to ſuppoſe that the ureter can make mechanical preſſure upon theſe nerves. But, firſt, an irritation is communicated to the neighbouring parts, an inflammation is excited, and ſuppoſe the hydraulic ſyſtem detached from the nervous, we

ſhould not obſerve any contraction of the cremaſter; it is from an inflammation ſpreading more readily to the neighbouring organs: and the bending of the body forwards, which takes place in an inflammation of the pſoas muſcle, chiefly proceeds from the eaſe the patient finds in that poſture by the parts being relaxed, and not that the muſcle is in a ſpaſmodic and convulſive action, for the patient can, though with difficulty and pain, extend the body behind the pſoas.

DXI.

In the ſmall nerves of the extremity thoſe are to be avoided carefully that run upon the ſides of the ſheaths of the tendons.

DXII.

Anatomical Preparation of the Extremities.

The ſuperior extremities are to be removed from the trunk. The clavicle is raiſed for this purpoſe, and the knife paſt under the articulation, ſo as to include the greater part of the pectoral muſcle; and, by directing it under the ſcapula, the clavicle, ſcapula, and ſubſcapularis muſcle will alſo be removed. A pipe is then to be fixed in the axillary artery, which becomes divided by the ſeparation of the parts, and another pipe is to be inſerted in one of the veins on the back of the hand; and having previouſly waſhed out the blood from the veins, the injection is to be conducted in the uſual manner, preventing its paſſing out in the time of the operation from the axillary vein, over which a looſe ligature ſhould be thrown.

The lower extremities are to be removed by opening the abdomen, and removing its contents, or placing them out of the way. A ſection is then to be made through the ſymphyſis pubis and its ligaments, and next through the ilium and ſacrum, ſo that along with the extremities one ſide of the pelvis may be removed. In injecting, the pipes are then to be fixed, one in the iliac artery, and the other in one of the large veins of the foot, as near as poſſible to the toes. The preparation is then to be finiſhed in the uſual manner.

Anatomical Preparation of the Hand.

An old emaciated female hand is the one preferable for this purpoſe. The forearm is to be ſeparated by a tranſverſe ſection above the wriſt, and the ſteel pipe fixed in the radial artery with a ligature. The quickſilver being poured into the tube, will ſoon fill all the veſſels, and begin to flow out where the ſection is made, and will thus remove any coagula. The veſſels are next to be ſecured, firſt catching them by the forceps, and applying a ligature over each, firſt over the arteries, and then over the veins. If not ſufficient, a general ligature, as a tourniquet, may be applied over the arm. When the veſſels are thus ſecured, the preparation is to be ſuſpended in water for a day without removing the pipe or ligature. The latter are then to be removed. Putrefaction is to be allowed to take place till the cuticle peels off, when the part is to be ſuſpended in the air to dry, and when dry carefully varniſhed. By ſuch preparations a beautiful diſplay of the veſſels is afforded.

DXIII.

Lymphatic Veſſels.

To finiſh the deſcription of the vaſcular parts, one ſet of veſſels, or the appendages of the thoracic duct ſtill remain, termed the lacteals and lymphatics, univerſally diſtributed over the body.

DXIV.

Theſe veſſels are ſmall pellucid tubes, which begin by numberleſs open mouths, viſible only by the aſſiſtance of glaſſes, ariſing every where from the ſurfaces, both external and internal. They ſeem every where to run in two ſets; a ſuperficial one, the branches of which are moſt numerous; and a deeper one accompanying the arteries, and in a double proportion at leaſt to the latter. They are termed lacteals on the inſide of the inteſtines from the white liquor or chyle they contain, and they are termed lymphatics wherever they are not filled by this fluid.

DXV.

Their general termination is in the thoracic duct, already deſcribed, and in no other parts of the venous ſyſtem do they appear to terminate.

DXVI.

The texture of the abſorbents ſeems ſtronger than that of the red veins, though it is too minute for a particular examination. Their muſcular power is apparent from their action, and by this power are their contents conveyed from their origin

to the thoracic duct, and urged on alfo by the motion of the furrounding parts. They are furnifhed alfo with blood veffels and nerves like the larger veffels, as difplayed by their fufceptibility both of inflammation and pain.

DXVII.

From their frequent communications and anaftomofes with each other in their courfe, they in general form an irregular net-work, which is moft numerous in the vicinity of the glands, into which they divide.

DXVIII.

Their whole extent is intercepted by valves of a femicircular form, placed in pairs, with one edge fixed and the other loofe acrofs the cavity of the veffel, but pointed towards the general termination. The fituation of the valves is not always regular, or at certain diftances, nor is their number always the fame in the fame fpace, though 7 or 8 are the ufual number in the length of an inch. Their number varies both in different bodies and in different parts of the fame body. The fize of the veffels, when diftended, is always largeft on the fide of the veffels towards their termination. Hence their jointed form in the lymphatics, and veficular appearance in the lacteals; and at the point of their termination there is always one or two fets of valves to prevent any regurgitation into them. Thus the valves promote the courfe

of their fluids, and prevent the regress of their contents as they pass on. By this set of vessels all fluids applied to their origin are taken up in consequence of capillary attraction, and urged on by the power of the vessels till carried into the general mass.

DXIX.

The glands connected with the absorbents are peculiar in their structure. Their situation in various parts of the body is under the skin, in the cellular membrane, or over the trunks of the different blood vessels belonging to the viscera. Their form is round, or oval; their size never exceeds an inch in diameter, and they are often collected into a mass, varying in colour in different parts, and at different periods of life, being large and reddish, or brown, in youth, but small and pale with increasing age. Under the skin, also, they are redder and firmer than within the large cavities, and are covered by a smooth dense membrane, which gives them a shining appearance, and is connected to the glands by cellular membrane.

DXX.

These glands, like others, are provided with blood vessels and nerves; and they possess sometimes internally a cellular appearance, at other times they consist of a simple convolution of vessels. The absorbents entering the gland, as they ap-

proach it ſpread into radiated branches, termed vaſa inferentia, and then penetrate its ſubſtance. From its oppoſite ſide, veſſels go out in the ſame manner as they entered it, termed vaſa efferentia; but they are larger and fewer than the former. Many of the abſorbents enter ſeveral glands before paſſing into the thoracic duct, and by theſe glands a change is certainly made on their contents; the particular nature of which is not yet aſcertained.

DXXI.

In examining the diſtribution of the lymphatic, or abſorbent veſſels, the ſuperficial ſet of the lower extremities which lie between the ſkin and muſcles belongs, in general, to the teguments. Round the toes they form a plexus, and the ſame on the foot, from which branches run along the knee. The ſame takes place on the outer as on the inner ſide; and the branches here divide, one part croſſing the tibia, and joining the ſame ſet at the knee; the other part, paſſing into the popliteal glands, and thence aſcending, in part, to the thigh, which glands are near the artery, and buried in fat.

DXXII.

From the knee a plexus from 12 to 14 trunks paſſes to the groin by the fore and inner part of the thigh, accompanying, in their courſe, the great ſaphena, and receiving branches from the adjacent parts in their progreſs, till they paſs into the

inguinal glands, which are from 6 to 12 in number, of different ſizes, ſituated in the angle between the thigh and abdomen, and part further down on the fore part of the thigh. The ſuperficial lymphatics are chiefly centered in the loweſt glands; and into this cluſter paſs alſo thoſe of the thigh, nates, abdomen, and loins.

DXXIII.

The deep ſet of the lymphatics of the lower extremity are few in number; they occupy the blood veſſels in their progreſs, and, like the former, paſs into the popliteal glands; and, as they proceed up, they accompany the femoral artery, and enter alſo the inguinal glands.

DXXIV.

Of the ſcrotum, the ſuperficial lymphatics enter likewiſe into the inguinal glandular cluſter, and the deep ſeated ones are carried, with thoſe of the teſticle, into the abdomen. The ſuperficial lymphatics of the penis run principally on its back, receiving branches from its inferior ſurface; and at its root they divide into right and left, paſſing on each ſide into the lower glands of the groin.

DXXV.

The deep ſeated ſet from the glands and body, accompany the arteries into the pelvis.

DXXVI

The teſticle is diſtinguiſhed by the largeſt and

moſt numerous lymphatics in the body, ſome of which exceed in ſize a ſmall quill. They ariſe from the coats, body of the teſticle, and epididymis, and paſſing into the ſpermatic chord, they terminate in the lumbar glands. The lymphatics in the internal parts of women go partly to the inguinal cluſter, and partly by the courſe of the round ligaments, and they terminate in the iliac, or lumbar glands.

DXXVII.

All the ſuperficial lymphatics of the under part of the belly, loins, nates, and round the anus, paſs into the inguinal glands; and theſe glands, thus ſupplied, ſend out but a few larger trunks in return, which enter the belly under Poupart's ligament, in company of the iliac artery. Having entered the abdomen, they are variouſly diſtributed to the glands above the iliac and lumbar veſſels.. The iliac glands being equal to thoſe in the groin, and the lumbar larger, and lying over the great veſſels and lumbar vertebræ; and in theſe glands alſo all the other lymphatics of the inferior extremity terminate, from whatever quarter they come.

DXXVIII.

Beſides theſe lymphatics, now deſcribed, on the inſide of the iliac artery, others are ſituated; on the outſide of it on the pſoas muſcle, one part part of which paſſes by to the lumbar plexus into

the thoracic duct; another part forms a plexus on the facrum, and from that proceeds to the fame termination.

DXXIX.

The lacteals again begin on the inner furface of the inteftines, each beginning upon one of the villi by fhort branches, which are furnifhed with orifices for imbibing the chyle. From the villi, their progrefs is along the outer coat of the inteftines, which they obliquely penetrate at laft, after uniting into larger branches in their courfe. Their progrefs accompanies that of the blood veffels, to which they are double in number, one being placed on each fide of a veffel; and both the fuperficial and deep-feated lacteals communicate in the fubftance of the inteftines; and, on leaving the inteftines, between the folds of the mefentery and mefocolon, they form a plexus, without regard to the courfe of the veffels. In their progrefs they pafs through a number of lacteal and mefenteric glands of different fizes, the latter being feated in the part between the layers of the mefentery, and fcattered over it at the diftance of two or three inches from the inteftines, of a white colour, and flattened before. The lacteals are largeft on the jejunum, and the glands are alfo largeft on that part of the jejunum connected with the mefentery.

DXXX.

By the ſize of theſe glands the lacteals have been divided into different orders. From the inteſtines to the glands forms the firſt order; one ſet of glands to another forms the ſecond order; and from the glands to the thoracic duct forms the third order.

DXXXI.

The ſmall inteſtinal lacteals, on leaving the meſenteric glands, in three or more large trunks accompany the meſenteric artery, and paſs in, for the moſt part, at the beginning of the thoracic duct. The large inteſtinal lacteals are centered in the meſocolic glands, and thoſe of the cæcum and right colon communicate with the ſmall internal lacteals; while thoſe of the left colon accompany the meſenteric artery, and are loſt in the lumbar glands.

DXXXII.

The ſtomach poſſeſſes two ſets of lymphatics proper to each of its curvatures. The lacteals of the ſmall curvature accompany the ſuperior coronary artery, paſs into the glands of the omentum minus, and obſerving the ſame courſe with thoſe of the liver, terminate in the thoracic duct. The lacteals of the great curvature go to right and left. The right ſide lacteals joining thoſe of the great omentum, and the plexus accompanying the coronary artery, run with the lymphatics of the liver

to the duct. The left fide lacteals join thofe of the fpleen and pancreas, and accompany them into the duct.

DXXXIII.

The lacteals of the liver run alfo in two fets, which freely communicate, and they are fo numerous as to cover almoft the whole of its outer furface. They difcharge their contents partly into the beginning of the thoracic duct, and partly to a plexus fituated on the fore part of the thorax.

DXXXIV.

The fpleen alfo poffeffes two fets of lacteals. The fuperficial fet is remarkably fmall. They pafs from its convex to its concave furface, and join the deep feated ones at the fiffure where the blood veffels enter, and they afterwards pafs through feveral glands, lying over the fplenic artery. The lymphatics, alfo, of the fpleen, receive thofe of the pancreas, which run into them, and the whole goes into the thoracic duct, near the termination of the lacteals.

DXXXV.

The fuperficial lymphatics of the kidney are only vifible in it when it is under difeafe. They run from without inwards, and terminate in the lumbar glands, and fo at laft in the duct. Thofe of the renal glands join the lacteals of the kidney.

DXXXVI.

The lymphatics of the lungs are numerous. The ſuperficial ſet forms large areolæ, with ſmaller ones within them. The large ſet runs chiefly between the lobules, while the ſmall paſſes ſo as to cover the whole ſubſtance of the lungs. From the ſurface they paſs to the root of the lungs, and enter the bronchial glands already deſcribed, (CCCXVI.), where they are joined by the deeper ſet that creep along the branches of the trachea and pulmonary blood veſſels, and through the medium of the bronchial glands the two ſets communicate. On leaving the bronchial glands, thoſe of the left lungs terminate partly in the thoracic duct behind the trachea, and another part paſſes through glands behind the aortal arch, and run by one trunk into the duct. Part of thoſe of the right ſide, after a convoluted courſe on the vena cava, opens into the trunk which terminates in the veins at the right ſide of the neck, and the reſt go into the duct near the diviſion of the trachea.

DXXXVII.

The abſorbents of the heart are numerous, but ſmall. Their principal trunks accompany the coronary arteries, the largeſt belonging to the left ventricle, and they all paſs to the neighbouring glands.

DXXXVIII.

The lymphatics of the æſophagus are numerous, and intermix with thoſe of the heart and lungs.

DXXXIX.

The ſuperior extremities, like the inferior, have two ſets of lymphatics, one lying under the ſkin, the other accompanying the principal blood-veſſels.

DXL.

The ſuperficial ſet is numerous; and ariſe from the fore and back part of the finger and hand, forming an extenſive plexus on the correſponding ſides of the ſacrum. Thoſe of the anterior part obſerve a direct courſe upwards, while thoſe of the poſterior ſeparate and paſs obliquely. From the bend of the elbow the firſt accompany or run near the baſilic vein, and enter ſmall glands in the courſe of the humeral artery; others do not communicate any where till they enter the axillary glands. Some branches attend alſo the cephalic vein, and afterwards paſs into the glands at the clavicle. The deep ſet accompany each principal artery, and uniting at the elbow, paſs on in two large trunks along with the humeral artery.

DXLI.

The axillary glands form a cluſter, varying in number and ſize, though leſs than thoſe of the groin. They are ſurrounded by much fat, and adhere cloſely to the trunks of the axillary blood veſſels and nerves. From them large branches enter the clavicle, and form a trunk which joins the duct near its termination on the left ſide.

The axillary glands receive the ſubcutaneous lymphatics from the back part of the thorax, of the teguments and muſcles of the ſcapula, and alſo from the mamma.

DXLII.

The lymphatics of the mamma are numerous; though the greater part paſſes through the axillary glands, others penetrate the interſtices of the ribs near the ſternum, and enter glands that paſs with the internal mammary veſſels.

DXLIII.

The lymphatics on the outſide of the head accompany the blood veſſels, and enter glands as they proceed to the neck; and then others, partly connected with the parotid gland, and ſome at the root of the zygoma. The lymphatics of the back part of the head enter glands at the root of the ear. Thoſe of the fore part accompanying the facial artery, and its branches, paſs into different glands ſituated at the buccinator muſcle, at the under part of the lower jaw, maſſeter muſcle, and the inferior maxillary gland.

DXLIV.

The lymphatics from the inner noſe paſs with the maxillary artery, and enter glands behind the angle of the lower jaw, where they join thoſe of the mouth. The lymphatics of the tongue and throat centre in the glands behind the angle of the lower jaw.

DXLV.

The exiſtence of lymphatics in the brain is highly probable, though not yet deciſively aſcertained.

DXLVI.

All the lymphatics of the head accompany the large veſſels in the neck, forming in their courſe a remarkable plexus of numerous glands, ſituated near the blood veſſels, termed glandula concatentæ, which are more numerous than any ſet in the body, and unite at the bottom of the neck into a trunk, which enters the duct on the left ſide, near its termination, and on the right goes into the trunk that forms the general termination of that ſide.

DXLVII.

Having thus traced the courſe of the lymphatics, ſomething farther is neceſſary with reſpect to their general termination in the duct. At its under extremity the duct is compoſed of three principal trunks. The firſt and ſecond conſiſts of the lymphatics of the right and left inferior extremity, and the third is joined by the lacteals or inteſtinal veſſels. From theſe is compoſed the duct over the 3*d* vertebra of the loins. In the thorax, the duct in addition receives the lacteal trunks of the intercoſtals of the æſophagus and of the lungs; and paſſing over after leaving the thorax to run between the longiſſimus colli and internal jugular

vein, it next makes a turn down to terminate in the angle formed by the left internal jugular and ſubclavian vein. In its whole courſe it obſerves a waving direction; and after leaving the thorax, ſometimes divides into two.

DXLVIII.

Chemical Analyſis of the Contents of the Lymphatic Syſtem.

The contents of the lacteals were already examined under the name of chyle.

The lymphatic veſſels, again, contain a colourleſs fluid, or a gelatino-albuminous water, having no taſte, and of a thin and ſomewhat plaſtic conſiſtence, being a ſolution of the ſuperfluous gelatin and albumen from every part, and the ſuperfluous aqueous vapor returned as it were to paſs anew through the general circulation, and to aſſimilate as it enters the thoracic duct, the chyle or nouriſhment on its primary entrance into the ſyſtem.

DXLIX.

Anatomical Preparation of the Lacteals.

The ſubjects moſt proper for lymphatic preparations are thoſe who have died anaſarcous; and in order to diſcover theſe veſſels, make an inciſion in the cutis, and remove it as far as the cellular membrane. In this part a magnifying glaſs will obſerve them, and then with the point of a lancet cut an orifice in one of them, into which introduce the pipe, which is to be kept in that ſituation by the finger, or a ligature; and when the cock is turned, the quickſilver will be ſeen to run up the lymphatics. As long as the column of mercury continues to leſſen gradually, we are to hold the pipe in its ſituation; and when it ceaſes to run any

longer, the injection is to be secured by a ligature, and the pipe withdrawn. The exit of the mercury from any collateral branch, is farther to be prevented by a needle and ligature. The injection being thus finished, the course of the vessel is to be cautiously traced with the scissors and forceps, avoiding any injury to the vessel; and should it take place, it is to be repaired by securing the injured part by the finger and thumb, and passing a fine ligature above and below the part.

During the progress of making lymphatic preparations, which are slow and tedious, the parts should be prevented from drying by avoiding their exposure to the air, or covering them with a wet cloth. When the preparation is finished, and cleared of all fat and extraneous matter, it should be dried in the air without heat, and when dry, varnished.

All the lymphatic preparations are made in the same manner.

DL.

Having now treated at length the structure of the animal body in a sound state, and its different parts, it will be proper to take a general view of the three great systems which support it, the vascular, absorbent, and nervous, in a connected manner.

DLI.

General View of the Vascular System.

Beginning then with the vascular system, we observe the coats of the arteries are of a considerable thickness; and as these require nourish-

ment and growth like the reſt of the body, numerous ſmall arteries are diſtributed on their coats, what writers call vaſa vaſorum. The coats of the pulmonary artery are ſupplied from the aorta.

DLII.

Structure of the Arterial Coats.

When the coats are diſſected, upon the outſide, beſides common cellular ſubſtance, or in ſome places the addition of membranes laid over the artery, as in the pleura within the cavity of the thorax, there is a looſe cellular ſubſtance every where; and on ſeparating it, we obſerve that the outer part of an artery is of a whitiſh colour. This whiteneſs depends on a tough and elaſtic coat, in which a number of exceeding minute fibres are interwoven in all directions, ſo that this outer coat may very properly be conſidered as cellular ſubſtance condenſed; for the fibres do not appear to run more in one direction than they do in another, ſo we ſhall call it cellulo-membranous, or the membranous external coat, which is of conſiderable thickneſs. This raiſed, we find within it one without fibres laid tranſverſely, or in a circular manner. Theſe are of a pale red colour, or paler than the principal muſcles of the extremities; ſo, examining the femoral artery, we find fibres of a paler colour than the muſcles of the extremities, but very diſtinct; but it is certainly carrying matters too far a great deal,

when the coats of an artery in general, or all the coats, are confidered as being cellular fubftance condenfed.

DLIII.

To judge from appearances, the name of mufcular is properly applied to this coat; and there is no more reafon, from any thing we obferve, to fuppofe it compofed of cellular fubftance, than to fuppofe any of our mufcles to be fo. Within the fibrous mufcular coat we find an inner coat, or we find this lined with an inner coat which is extremely thin, but very denfe; neither is it ftrong, and it has lefs toughnefs than we fhould have expected, having fcarcely any of the elafticity proper to arteries; for, if the outer coats are diffected, it fcarcely admits of being ftretched; and thefe three coats are connected to each other by the common cellular fubftance of the body, as in the alimentary canal, &c. In other animals, as that of the ox, and efpecially in the whale, the fibrous coat is ftill more evident and diftinct.

DLIV.

Next, in the coats and ftructure of the veins, thofe of the fmall ones are fo thin and tranfparent, that we cannot diftinguifh the one from the other; but in the larger veins we find nearly the fame number. The fecond is fomewhat reddifh coloured in the larger veins. In it we can diftinguifh fibres, but very different from the fibres of

an artery; for they are not placed chiefly in a circular manner, but so many run length ways; these are crossed by others, and the threads of both are interlaced; so that we are at a loss, judging of it merely by inspection, to determine the nature of that coat. Next the blood is a membranous thick coat, which is tougher than that within the arteries; and the elasticity of the veins very much depends upon the inner coat, whereas in the arteries it depends chiefly upon the outer coat. The cellular substance, too, is rather looser, so that we can separate the external coats easier from the internal than in the arteries.

Such is the general structure; and from it we proceed to trace the course of the blood.

DLV.

In respect to the shape of an artery, many authors have described it as if it was conical; but if we attend to it, in any place where minute branches are not sent off, we find it cylindrical; or we may compare an artery to a tree, which we are likewise apt to imagine of the conical shape, not attending to the change made by the wood furnished to the branches from the trunk, for between the branches it is likewise cylindrical.

DLVI.

In regard to the mode of ramification, or the proportion in which an artery branches, compared with the trunk; as on the right side of the

neck, for inſtance, and at the bottom of the abdomen, it is evident that the two branches joined together are larger than the trunk, and the proportion nearly, as commonly alleged, is as three to two; the two joined together are a third larger than the trunk which forms them. Hence, as we find ſuch diviſions, and ſubdiviſions of arteries, frequently repeated, as in the meſentery, the ſum of all the ultimate branches of an artery, or their capacity, muſt be conſiderably greater than that of the trunk; and therefore, inſtead of conceiving that the arteries are conicals with the baſis turned towards the heart, we may juſt invert this, and compare the arterial ſyſtem to a cone with its point beginning in the heart, and the ſize continually increaſing to the moſt diſtant extremities.

DLVII.

With regard to the kind of angles which the branches of the arteries form, in general we may obſerve that the blood enters them in a favourable direction, or that the angles are acute; but in this there is the utmoſt variety, which partly depends upon neceſſity and ſituation, partly upon the uſe which the arteries ſerve; for in many places we find them ſent off nearly at right angles, and in ſome few the angle is turned back in the moſt unfavourable way, the blood moving retrograde, as it were. Upon the whole, we may obſerve, that near to the heart the angles of the

arteries are greater than at a diſtance. Nature ſeems to endeavour to render the flow in all as equable as poſſible. So we find many arteries of the trunk that are deſtined for muſcular organs, ſent off nearly at right angles; whereas, in the extremities, they are almoſt every where acute. Perhaps, further, we may remark, that near to the heart the arteries ariſing from the trunk are ſpread out in a greater number of branches. Following an artery to the place where it is intended to be diſtributed, we frequently find, almoſt without exception, that the neighbouring branches communicate, or we diſcover a beautiful net-work of the branches, as in the alimentary canal; ſo that, although a number of branches were ſtopped, the blood could penetrate to the extremities of every branch; and if, in the courſe of the artery from the heart to the diſtribution, there is any danger of a conſiderable ſtoppage, we find conſiderable anaſtomoſes in the large branches, as in the meſentery.

DLVIII.

It is impoſſible to trace, by diſſection, the arteries to their ultimate termination with our ſenſes unaſſiſted. A microſcope is required to view the circulation in a living animal; for, if we attend to the circulations that have been made by the moſt eminent phyſiologiſts, it is proved to our ſatisfaction, that three or four thouſand of ſuch

arteries as circulate red blood laid together, do not exceed the breadth of an inch; or, that the ſmalleſt hair exceeds the diameter of the artery at leaſt in the proportion of twenty to one; or, that four hundred ſuch arteries circulating the red globules joined together, would not be larger than a ſingle hair. Hence, after we have forced an injection from the arteries into the veins, or into the moſt minute branches of the arteries, we perceive little more than an uniform red colour with the naked eye, as in the innermoſt coats of the alimentary canal.

DLIX.

The veins returning from the extremities of the body, in their firſt origin imitate the arteries in their appearance, and there muſt be the ſame number of them. There are two ſmall anaſtomoſes, which are occaſionally repeated in the progreſs of the veins towards the heart; and theſe anaſtomoſes are, in general, more frequent in the veins; for, as the force of the blood is leſs here than in the arteries, there is a greater danger of its ſtoppage. And, for the like reaſon, where the veins are ſubjected to unequal preſſure, as where they run among muſcular organs, in the trunk of the body, the head, and extremities. Within the veins there are numerous valves, or flood gates; and wherever the veins appear joined, there a pair of valves are to be found. Nor is

this alone ſufficient; but in the muſcular parts two ſets of veins are conſpicuous, one following nearly the courſe of the arteries, and the other running under the ſkin; where they are as little expoſed to the action of the muſcles as poſſible. And not only do theſe anaſtomoſes take place, but we find branches paſſing from the one to the other, ſo that on opening a vein the flow of the blood is increaſed by cauſing the patient to play with his fingers, which puts the muſcles in action, and preſſes upon the deeper veins. When the veins are traced from all the parts of the body to the heart, we find that the two venæ cavæ, joined together, are conſiderably more capacious than the aorta, nearly in the proportion of two to one, for the inferior is nearly as much larger than the aorta, as the ſuperior is ſmaller than it. With this general ſtructure we are led to conſider the action of the parts by which the circulation of the blood is performed.

DLX.

That the blood is carried conſtantly in a circle, appears from the vaſcular ſtructure which directs it in its courſe. We find valves at the mouth of the ventricle of the heart, at the mouth of the arteries, and in many places of the veins; and, again, where the inferior cava terminates in its correſponding auricle. If we examine living animals, this is made ſtill clearer. We find proof

of the motion from ligatures made upon the veſſels, or from wounds inflicted, or from the transfuſing the blood out of the body of one animal into another's body; or we ſee proof from the infuſion of medicated ſubſtances, which, when poured into a ſingle vein, or artery, affect the body univerſally, and the blood may be ſhewn moving with the microſcope.

DLXI.

The rapidity of the motion is likewiſe eaſily demonſtrated. Thus we ſee, that a vaſt quantity is loſt from a wound made even in the correſponding artery, the diſcharge would be greater, becauſe the veins are more capacious than the arteries, and therefore the flow of blood is ſlower; or we ſee the proof from the transfuſion of the blood; or without any regard to experiments, we have only to attend to the quickneſs of the pulſe, to the frequency of its ſtrokes, and to the capacity of the heart. From them we perceive that a prodigious quantity is paſſing through the heart in a very ſhort ſpace of time, our pulſe beats between 60 and 70 times in a minute; when a perſon is laid at reſt in bed, ſuppoſe it 64. Thus, if a ſingle ounce of blood be thrown out from the left ventricle of the heart in each pulſation, it is evident that there paſſes through the heart in a ſingle minute 4 pounds of blood; but if we double the quantity, which from the ſize of the ventricle we

may eafily do, eight pounds may pafs in a minute; therefore, in the fpace of an hour, blood, equal in weight to thirty ftones, or perhaps to three times the weight of the animal to which it belongs, paffes in that fpace.

DLXII.

This velocity of the blood depends upon the action chiefly of the auricles and ventricles of the heart; and thefe act alternately. Whilft the auricle is filling from the veins, the ventricle is emptying itfelf; and whilft the auricle empties itfelf, the ventricle is filling; and the ufe of each is clear, in order to give room by their being a receptacle added to the heart. There is no alternate confiderable dilatation of the veins; for, whilft the ventricle is in action, the blood continues to flow, as before, from the veins into the auricle; and as foon as the ventricle ceafes from its action, the auricle, now ftimulated by the blood, contracts, and the blood flows into the ventricle with great quicknefs, whilft, at the fame time, an addition is made from the veins. Hence the auricles are fmaller than the ventricles, and there is nothing placed to prevent the flow of blood continuing into the auricle directly from the veins during the contraction of the ventricle.

DLXIII.

What is known of one fide of the heart applies to both. We conceive that the two auricles are

filled and emptied at the ſame time, but at a time different from the ventricles; having, as appears from this, a common ſeptum, and we cannot ſuppoſe that the half is relaxed, and the other in action. Indeed, the ſynchronous actions of theſe parts may be ſeen in a living animal. But though the auricles and ventricles are emptied at the ſame time, they are not entirely emptied, but nearly ſo; for the right ſide is ſomewhat more capacious than the left, ſo this certainly does not empty itſelf fully, but they do very nearly; and, we may ſay, that the auricle is filled and emptied alternately. But our blood veſſels are in a very different ſtate. The ſides of the arteries do not come into contact when in action, only they are more ſtretched at one time than at another, and are more ſtretched when the ventricle is in action; but they are by no means emptied when they contract, and this leads us to attend to the cauſe of the pulſe.

DLXIV.

When the finger is applied to the artery, it is underſtood, in general, that the artery ſtrikes the finger, becauſe the blood is driven from the heart into it with violence. But, farther, what changes does this produce? Are we to ſay, that the artery is merely dilated, its diameter increaſed? Or, are we to ſay, that it is not dilated, but lengthened, in conſequence of which it

changes its place? Or, are we to adopt both? We certainly muſt; for to imagine that an artery is not dilated, is improbable. We find that it can be drawn out in its diameter, as readily as in the length, and it re-acts with conſiderable force; and the muſcular fibres, on which the elaſticity in a great meaſure depends, are placed in a circular manner. It is in vain to allege, that when we make a computation, the quantity of blood that the heart ſupplies appears to be inconſiderable, conſidering, at the ſame time, the great capacity of the arteries; and, therefore, that the change in dilating them cannot be obſerved. For, in this computatiou, it is taken for granted, that the whole is diffuſed univerſally in the arterious ſyſtem; but the arteries beat ſucceſſively: and, if one hand is laid on the carotid artery on the neck, and another upon that on the top of the foot, it will be perceived that the one ſucceeds the other, and the dilatation, as well as the elongation and change of place in the artery may be plainly ſeen; but both ſeems leſs to the eye than to the finger, for we are affected by the force of the percuſſion, and imagine the motion greater than in reality it will be found to be. Hence, when we throw an injection into it, the artery, inſtead of becoming ſhorter and ſtraighter, is lengthened out, becomes more ſerpentine, and at the ſame time is dilated.

DLXV.

By what powers, after the arteries have given a ſtroke to the finger, do they recover their former ſituation? Is it merely by their elaſticity, or that whilſt they are elaſtic, they are likewiſe muſcular? Their elaſticity is known, and the uſe of it is apparent; it is intended to prevent the whole force of the heart from being ſpent: the force is eluded by the yielding of the larger branches, and the impulſe is continued, inſtead of being given in one moment. Nothing is loſt, and nothing is added by the elaſticity. The force is as much loſt by the yielding, as it is increaſed by the re-action; the force is the ſame, but divided; part of it is employed when the heart is in action, and then it is continued when the heart ceaſes.

DLXVI.

With this elaſticity a muſcular power is joined, for the fibrous coat is truly muſcular; and we may, therefore, with certainty conclude, that the arteries are muſcular organs capable of irritation, of varying their action occaſionally in health, and in diſeaſe; and the proof of this is full and complete. The contractions of arteries are apparent when irritated, and a greater motion is performed at the place irritated than elſewhere. In many inſtances this cannot be ſhown ſo clearly as might be expected; but the ſame is true in other organs. Thus it has been found, that the veſica urinaria

may, on certain occaſions, be wounded and cut on the outer ſurface without ſuffering a contraction of its fibres; and many difficulties are to be had in view here. If a ligature is thrown upon an artery in order to intercept the blood, that it may be ſeen what paſſes beyond the ligature; or an inciſion is made, then may have been compreſſed or divided thoſe very nerves on which the motion of the cut muſcle depends. The irritation, too, is applied not in the natural way. It has been made upon the outer ſide, whereas, if applied to the inner ſide, the effect may be very different. Thus, whilſt the arteries poſſeſs the muſcular power, they poſſeſs at the ſame time the elaſtic; and it is by no means improbable that in ſeveral places the elaſticity ſtraightens the artery as much as the muſcular power can do, ſo that it is not made ſmaller in life, but a greater impulſe only is given to the blood. If theſe things are properly conſidered, and the experiment made with accuracy, we will be able to diſcover the motion of the muſcular coat of the arteries, to which may be added the obſervations made by diſſections, or otherwiſe. The reſemblance between arteries and the inteſtinal canal is to be alſo taken into account. We ſee fibres in both, paler than theſe moving the extremities; and any perſon judging merely from the appearance, would call it the muſcular coat. We find in certain places nerves

fent into it. This is proved by the appearances under difeafe, for the exiftence of fpafm muft be allowed in different difeafes. Do not we fee fuch effects in hyfteric perfons, or in the ague? or the effect the paffions of the mind have, or the effect of mechanical irritation upon the glands; not only the quantity of the fecreted liquors is increafed, but their nature is altered by irritation. Laftly, it is proved by the effect of topical ftimuli.

DLXVII.

For the increafed action of the veffels being excited by topical ftimuli, gives a proof of the living power of the arteries. And thus, befides the contractile power, the living power is much more active in the extremities than in the beginning of the arteries; and, could they be equally fubjected to experiment, we fhould find much greater changes produced.

DLXVIII.

The further proof of the mufcular power of the arteries, appears from the diffection of them; the regular courfe of their fibres placed circularly; and from their being provided with nerves, as appears from their fympathy with the other parts of the body. There are many other circumftances which meet together in the fame point. We find, that after the death of animals the arteries are empty of their blood, and the veins diftended with it; and there is no doubt that this would be found to

be the cafe, although the heart were fuddenly cut out of the body, the arteries would be found capable of expelling their blood forwards to the veins. Befides, feveral circumftances may be mentioned, as their being actuated in a different manner in different parts of the body, for the arteries have been found to beat more frequently in one part of the body than in another. But independent of this, our proof is full and complete. Not only the paffions of the mind, but topical irritation, alters both the quantity and kind of fecreted liquors. Irritation produces inflammation, as it is applied to the right eye; and this is not to be explained by fuppofing that the heart is irritated, and drives the blood forwards; for, were that the cafe, the other eye fhould be equally affected; but the veffels of the part are thrown into unufual action.

DLXIX.

From the enlargement of the arteries, the refiftance made by their different angles, from their fize, the extreme fmallnefs of their terminations, and the infinite number of branches into which they terminate, &c. the ftroke of the heart is infenfibly loft. Not but the vis a tergo continues, and pufhes on the blood into the veins; and its force reaches farther than is commonly fuppofed. When we obferve the circulation in a vigorous animal, we obferve that the blood is pufhed on in

a uniform ſtream ; but when the animal grows languid, and the blood begins to ſtagnate, ſo that it requires a conſiderable effort, the ſtrokes of the heart may be numbered by looking at the veins, and thus the blood is ſeen moving on a certain way.

DLXX.

Beſides the vis a tergo, the veins likewiſe poſſeſs a living power, independent of their elaſticity; and it would appear that the ſmalleſt veins, like the ſmaller arteries, poſſeſs it in the greateſt degree. Nay, in the largeſt veins, we perceive a greater alteration made by heat and cold in a living than in a dead body, owing to that activity of their coats, ſimilar to what the arteries poſſeſs, eſpecially that we find many of our veins, particularly the lacteals, in which we can ſtill leſs demonſtrate muſcular fibres, are capable of emptying themſelves very completely, independant of a mechanical external preſſure made upon them. The larger veins are capable of being irritated in life, of having their coats inflamed and thickened.

DLXXI.

Thus the blood moves in the veins towards the heart by the vis a tergo, the muſcular power of the veins, and the preſſure made upon them by the action and ſwelling of our muſcles, while other circumſtances may have a leſs conſiderable effect. The motion appears nearly uniform in the veins,

till we come near to the heart; for the motion of the blood from the heart is broken; and, unless in an extraordinary situation of the body there is no stoppage, because the auricle receives the blood from the veins during the contraction of the ventricle, and there are no valves interposed which can stop its course, for a very moderate impulse is sufficient to distend the ventricles, which we are not to look upon as a spring, but as yielding to a gentle impulse, so that valves were unnecessary. And, where the respiration is much impeded, if there had been valves pressing mechanically upon the auricles, it might have sent the blood backwards into the vena cava, and in this case we do find it pressed backwards, and a pulsation in the branches, which immediately terminate in the cava.

DLXXII.

When we compare the force of the blood in the arteries with its force in the veins, by fixing a tube in them, we find that the blood rises ten times the height in the arteries that it does in the veins; *i. e.* it loses nine tenths of its force in passing through the arterial system. Hence one, and a primary purpose of the heart, is to renew the force of the blood; and upon this activity of the heart the circulation in a great measure depends. It is in vain to imagine that the blood runs from the venous system into the heart with

a force ſufficient to continue its motion. We ſee that the heart and brain, by acting upon each other in a circle, have an advantage over every piece of machinery in continuing the motion of the blood with almoſt unimpaired vigour.

DLXXIII.

But there are many other uſes which the circulation of the blood ſerves.

1. The thoracic duct terminates in a large vein near to the heart, and the heart and arteries are perfectly well fitted to mix the chyle with the maſs of blood.

2. The general motion of the chyle through the heart and arteries forms it into blood, all parts contributing their ſhare, ſome more than others, and eſpecially the lungs, occaſion the converſion to be complete, by the appearance of red globules which is acquired from the degree of oxydation that gives them colour, and this appears wherever we compare breathing animals with others, or conſider the effect which air has upon the maſs.

3. The blood thus formed, is preſerved in a proper ſtate of fluidity, and the coagulation in a great meaſure prevented. The exceſs of air, indeed, diſpoſes to the coagulation of the blood, as appears in morbid caſes. Thus a quantity of fluid contained in the cavities of the pleura, when the body is opened, though perfectly fluid, in a few

feconds after expofure to the air will coagulate, which fhews the effect of the air in producing that circumftance; but this does by no means fhow that certain parts of the general mafs cannot be coagulated without that. On the contrary, all anatomifts have found it coagulated in the ventricles of the heart, and we fee it quickly taking place in aneurifm; and after tying a large vein in two places, the blood has been found coagulated in it. In fhort, upon a variety of occafions, we fee the fpontaneous feparation of the blood into its conftituent parts, and find a coagulum of confiderable firmnefs in no great length of time.

4. The circulation conveys the nutritious parts every where, and applies the nourifhment repeatedly; for the parts of the chyle, or of the blood, are hereby repeatedly applied to their proper organs, in order to be feparated from the general mafs. Thus the feparation of the milk depends upon this circumftance; the fame quantity could not be collected without the conftant motion of the blood in a circulation, and in like manner with regard to the other fecretions.

DLXXIV.

There are other purpofes which we fhall afterwards more clearly difcover, while we confider the effect of the glands in certain parts of the circulating fyftem, by which not only a feparation is made, but the liquors are changed at the fame time,

and a difference made between the fecreted liquors and the red blood, in the fame manner as between red blood and the chyle.

DLXXV.

We find many other circumftances depending upon the fame caufe. The growth of new parts is fupplied, and that in a manner that is extremely curious, and which is almoft inexplicable: for, after making an incifion in a part, a circulation can be reftored between the oppofite fides of the incifion; or, if a lofs of fubftance happens in a part, a great number of new veffels are formed. Were we only to confider a formation of arteries, it might not appear fo ftrange; but how do thefe join with veins to return liquors to the heart? the thing certainly happens, that the new arteries meet with new veins that return the blood.

Other phenomena may be fuppofed to depend upon the circulation, but they cannot be fhown to do fo with equal certainty.

DLXXVI.

Abforbent Syftem.

From viewing the arteries as ferving merely for the purpofe of circulation, we now proceed to confider their termination, and the beginning of the veins more particularly; and in doing this we fhall alfo review thofe veins which are univerfally known as the fyftem of the valvular lymphatics. They are generally pellucid, and every where

crowded, as is found, with valves; ſo that in an inch eight pair of theſe valves may be reckoned, and their ſtructure is exactly the ſame in the human body as that of the valves found in the red veins. There are almoſt always two valves together, each deſcribing its ſemicircle, and filling the vein exactly. As it is of very conſiderable conſequence, not only in phyſiology, but in practice, to underſtand their courſe as well as ſtructure, they deſerve a particular demonſtration.

DLXXVII.

We find that they enter into ſmall knots, or glands, which have been deſcribed, from their ſhape, under the name of conglobate glands. When they reach, they divide into a very great number of branches, which are ſo minute that it is difficult to force a penetrating injection through them. When we ſucceed, we find, that after dividing within the gland, the extremities of the veſſels open into cells which are natural to theſe glands, and in which the chyle and lymph are depoſited; for, in deſcribing them in general, it is all one whether we take the lymphatics come out from the ſmall glands beginning equally ſmall, and a number of theſe minute branches joining together form the trunk. So we may call the firſt of theſe vaſa lymphatica ingredientia, and the others, the vaſa lymphatica egredientia, ſuppoſing, always, that a cellular matter is interpoſed; juſt as when blood is thrown by the arte-

ries of the cellular ſubſtance of the penis, it paſſes into cells, and from thence into the veins. Theſe veſſels, in their courſe, have numerous anaſtomoſes. Thus, two lacteals run a certain way parallel, each ſends off a branch, which are united to form a third, and each of theſe three is again ſubdivided, and thus we may purſue the anaſtomoſes a very great way; and hence no lacteal can be readily obſtructed, for, if the paſſage is denied to the right hand, the liquor can run to the left. When the lymphatic reaches a conglobate gland, the whole of it does not enter into the gland, but it divides upon the ſurface into different branches, ſome paſſing over the gland, and others entering it; and they communicate again on the other ſide of the gland; and, therefore, though the gland ſhould be obſtructed by diſeaſe with an oſſeous, or rather cretaceous matter, &c. ſtill the lymph can paſs on. When we follow the lymphatic and lacteal ſyſtem, we find one principal or general termination in the thoracic duct.

DLXXVIII.

In tracing them from the extremities, we perceive two ſets, one accompanying the ſubcutaneous veins, the other the arteries and deep ſeated veins; and as they run upwards, the deep plexus comes nearer to the ſuperficial. When we trace them near to the groin, we find the ſuperficial plexus

paſſing into the inguinal glands, and from theſe the egredientia entering the trunk behind the tendon of the external oblique muſcle, while ſome of the deeper branches are ſeen entering at the ſide of the pelvis, and repeatedly the ſuperficial veſſels communicate with thoſe following the artery, then within the body they enter other glands. Therefore, we take it for granted, that the ſhewing a conglobate gland is the ſame as ſhewing lymphatic veſſels; and running up alongſt the loins, they paſs through the glands of the lumbar plexus, and here they meet with the lacteal veſſels, the lacteal trunk joining with the lymphatic, and running to the receptaculum chyli. The thoracic duct, in its courſe, receives the lymphatics of the trunk; and, where it makes a turn to open into the internal jugular, there enters a large lymphatic, which receives the lymph from the left ſide of the head and neck.

DLXXIX.

Thus we have ſeen that the thoracic duct receives the lymph from the lower extremities, from the pelvis and abdomen, with the chyle from the chylopoetic viſcera, then, in its paſſage upwards through the thorax, it receives the lymph from the heart and lungs. We find the plexus from the left arm going through the axilla, and running towards the thoracic duct with the lymphatics of the left ſide of the head and neck; while thoſe of

the right arm, and of the right ſide of the head and neck, enter the internal jugular vein of the ſame ſide, and right ſubclavian.

DLXXX.

The general termination of the arteries has been hitherto mentioned in circulating veins, without any regard to the colour or nature of theſe veins; but when we attend to the compoſition of the blood, that there are found in it red globules of a conſiderable ſize, and that the parts compoſing the ſerum and lymph are inviſible to the microſcope, we may ſuppoſe that ſome of the terminations of the arteries, thoſe that convey the red globules, are conſiderably larger than others which convey the ſerum or lymph only; that, as we find the blood, when ſet to cool, divides into two parts, a red part and a colourleſs, we might naturally ſuppoſe, farther, that in the courſe of circulation theſe parts were ſeparated ſomewhat in the ſame manner. When we compare with this notion the appearance of colour in different parts of the body, ſuch a ſeparation muſt actually take place. We find no red blood within the cartilages, nor any red veſſels upon the clear part of the eye, and hence we certainly will admit that there are arteries of a deſcending ſeries; thus there are red arteries, and others to which we may apply the name of ſerous or lymphatic. When we uſe the term lymphatic, we do not mean that the

coagulable lymph, unmixed, paſſes through theſe, but that this is conveyed by a certain portion of the ſerum; but we can even ſuppoſe the ſerocity ſeparated from the lymphatic part, and again pure water taken in by drink, ſeparated from both; and it is beyond all doubt, that there are ſerous as well as red arteries.

DLXXXI.

Beſides thoſe performing circulation, we all know that many parts are ſeparated from the blood; that there are ſecerning veſſels, that make a ſeparation either of what is hurtful to the body, were it to remain longer in the courſe of circulation, or what may be uſeful in various reſpects, as milk to nouriſh the child, or bile and other liquors that are afterwards to be employed for uſeful purpoſes, for the preparation of our aliment.

DLXXXII.

The ſecretion may be made in a very ſimple, or in a very complex way, and that varying in different parts of the body. For, whilſt we uſe the term of ſecerning arteries, we would be underſtood to mean that, whilſt the arteries make a ſeparation, they at the ſame time alter the liquors that paſs through them.

DLXXXIII.

Authors generally imagine that the liquors which are little changed, perhaps ſcarcely at all changed,

merely water are ſecreted from what is called an exhalant artery; but of late years, ſome authors of eminence have taken the fancy of denying that there are exhalant arteries, and would perſuade us that, were we not to obſerve a glandular maſs, the ſecretion is performed through inorganic pores. But this is improbable and inconſiſtent with anatomical facts on the different parts of our body, as on the inner ſide of our lungs, and of the alimentary canal, we find glands for the ſeparation of ſlime or mucus; but, beſides this, there is a ſecretion of matter which poſſeſſes very ſingular powers and properties, which is depoſited into the trachea, and impregnated with a remarkably poiſonous quality. The matter ſecerned into the cavity of the ſtomach and inteſtines, poſſeſſes ſingular properties in diſſolving our aliment: can we imagine that ſuch variety is made by an exudation through inorganic powers? Are not we rather to ſuppoſe that the ſtructure is organic, and highly curious, through which ſuch liquors can be produced. If we puſh an injection a little, we perceive regular terminations of theſe veſſels into cavities which can be plainly demonſtrated. And we obſerve that even the quality of theſe ſecreted liquors can be varied and modified by irritation. Thus, upon the ſurface for inſtance, the ſecretion is affected in various diſeaſes by ſpaſms. Therefore, though the notion of exhalant arteries has

rather been taken for granted, than proved by ſyſtematic writers, the more we conſider the matter we ſhall the more readily adopt the idea. Generally there is a knot or gland interpoſed, into which we trace the termination of arteries, as in the ſeparation of the bile, &c.

DLXXXIV.

From the facts thus ſtated, there can be no doubt that the red arteries divide into coloured and colourleſs branches, that many of the colourleſs branches ſerve for the purpoſe of ſecretion or excretion, or that we find exhalant arteries ſent off. In other caſes, a number of arteries collected, by their complication form a knot or gland, from which we find a duct ſent out, while others of the colourleſs branches, with the red extremities of the arteries, perform the circulation. Thus we cannot doubt that the cornea of the eye has a circulation through it nearly in the ſame manner, as that performed in the other coats.

DLXXXV.

But it remains that we determine the courſe theſe fluids afterwards take to return to the heart. There muſt be circulating veins correſponding to the red and lymphatic arteries, and there muſt be abſorbent veins that ſuck fluids in, correſponding to the exhalant and ſecerning arteries, and beſides, ſerving a variety of other purpoſes. Thus the moiſture is taken in from the air, and we all

know that medicines can be taken in as mercury, the ointment rubbed on the ſurface having the ſame effect as when ſwallowed, and the chyle is taken up from the alimentary canal.

DLXXXVI.

Thus there are two kinds of veins, the red veins and the valvular lymphatic veins; in what manner are we to ſuppoſe them formed?

DLXXXVII.

That the red arteries terminate with the red veins, is beyond all manner of doubt; but how are we to ſend back the liquor contained in the lymphatic arteries, or ſucked in from the different cavities? Are we to ſuppoſe with ſyſtematic writers that the lymphatic arteries from the valvular lymphatic veins paſs through the glands, and that the abſorbent veins paſs into the red veins? Or are we to conceive that the red arteries form the red veins, and the lymphatic arteries form the lymphatic veins, and that the abſorbent veſſels which are colourleſs, terminate in the colourleſs veins; the valvular lymphatic, ſuppoſing the red part of the blood to go by the red veins, and the abſorbent liquors by both.

DLXXXVIII.

Or is there not another ſuppoſition ſtill much more probable, a ſyſtem that is much more ſimple, viz. As an artery in its extremities divides into red and colourleſs branches, would we not ſup-

pose that the red veins, in like manner, are formed of coloured and colourless branches, and that both join together to form the red veins, and that they thus correspond with the arteries in one of their principal offices, of carrying on the circulation, and in that only whilst the valvular lymphatic veins correspond with them in so far as they perform secretion, or that they receive all the liquors that are any where effused, so that the circulation is carried on by the red veins, and absorption by the valvular lymphatic veins; and that these have open mouths beginning from the surface, and from all the cavities of the body, so that the fluids do not pass directly into them by the force of the heart.

DLXXXIX.

In order to fix a proper opinion, it is necessary to state facts and experiments, as well as arguments from the nature of things, to establish some fixed opinion; and the first thing in doing this is to shew that authors have, not as they suppose, given an absolute and direct proof that the valvular lymphatic vessels proceed from the arteries. The arguments used for this purpose, though at first sight plausible, and seemingly conclusive, when properly examined, are founded in error.

DXC.

As we observe the blood out of the body to divide into a red and colourless part; and, as we

find in the body coloured and colourlefs veins, there can be little doubt that each of the veins correfponds to the parts of the different colours; but furely this obfervation touches not the origin of the veins. Nothing is thence concluded with regard to that. From there being in the body parts that are colourlefs, we may conclude that the arteries divide into coloured and colourlefs branches; or we get a proof that there are more arteries than we perceive with the microfcope, the colourlefs branches efcaping us from their fmallnefs and the want of globules; fo that we have no manner of judging.

DXCI.

The next argument is more direct. We have been told, by a fucceffion of anatomifts, and told truly, that when an injection is thrown with violence into an artery, the injected matter is found to fill the valvular lymphatic veins. But feveral circumftances have been overlooked by the chief perfons who have made thofe experiments. There was a laceration of the tender branches of the artery, an effufion into the cellular fubftance, and a laceration of the branches of the lymphatic veffels; and the mercury had entered at the lacerated places, which often happens, and without laceration it never fucceeds; but if we fill the veins at the fame time with the arteries, we feldom remark any of the

lymphatics filled; whereas, upon pushing an injection suddenly, the materials not of the most penetrating kind, we shall have the lymphatics injected, and not a drop in the veins; and in many preparations formed of the testicle, many of the lymphatics are filled, some of them very small. The valves prevent the filling them by their trunks, and none of the blood vessels have the matter injected into them; and the manner of injecting them is to bruise the same substance, to pour the mercury into a hole, and to work it into the several branches of the lymphatics: so we do not find any proof, from these experiments, that the lymphatics are continued from the blood vessels, which is all the use that we can make of such experiments; for it is not meant to hint that the mercury passed in at the most minute mouths of the lymphatics.

DXCII.

There is another argument of considerable weight; that the lymph is sometimes found coloured with the red part of the blood. This observation likewise is just, and what is seen repeatedly in living animals; nay, constantly, it is the case wherever, by a wound made upon a living animal, the blood is effused, or the finer parts of it, a bloody water, whether in the cellular substance or larger cavities of the body, but more especially if by the wound sensible parts have been

expoſed to the air, ſo as to become inflamed; and it matters not which of the bowels are expoſed to produce this effect of tinging the lymph red. Now, what reaſon is there for ſuch an appearance? are we to imagine that where the red colour is found, where perhaps red globules are found in the lymphatic veſſels, that the whole arterial ſyſtem has been dilated ſo as to allow theſe to paſs? Only attend to ſome of the inſtances; there was nothing before hand to produce the dilatation, which muſt have taken ſome time. In the appearances which follow every inflammation, a bloody matter is effuſed into the cellular ſubſtance, and this circumſtance was not attended to by thoſe who draw the concluſions that the red colour ſhowed the continuation of veſſels; and they overlooked this circumſtance, that the red globules break down into inviſible parts; ſo they are perhaps as capable of being abſorbed by the ſound mouths of the lymphatics as any of the other parts. Nay, more readily perhaps; becauſe where the whole maſs is effuſed, the red colour diſappears before the yellow. Inſtead, therefore, of this obſervation proving a continuation of the valvular lymphatic veſſels with the arteries, it rather ſeems to ſhow the contrary, that the lymphatics begin by open mouths from theſe cells, into which, in caſes of inflammation and wounds, the red particles are effuſed.

DXCIII.

No proof, therefore, is afforded of the colourless arteries terminating in the lymphatic veins; but do we find any that the colourless arteries do not terminate in red veins? Every circumstance leads to the supposition that they do. This we find founded first on the analogy of arteries.

DXCIV.

An artery, at its termination, consists of coloured and colourless branches. Why should we not suppose a vein at its beginning to consist of the same? It must be admitted, that nature forms no more of the colourless part of the blood than is proper for the purposes of life, for maintaining the diffusion and separation of the red globules from each other, and for many other uses. Now, if these parts be necessary where the fluidity is preserved by the greater agitation of the heart and arteries, they are certainly more so where the circulation is more languid; and, therefore, after the necessary secretions are made, the remainder should return to be added again to the red globules. Hence, instead of imagining that this part is carried away from the red veins, we must suppose that after the colourless arteries have made their dispersion through a colourless organ, they run into red veins. Thus in the eye of a child we find arteries conveying red blood, which afterwards become too small to admit the

globules, yet the termination of thefe arteries muft ftill be in the red veins; and, when we view the different places of animals in which the lymphatic fyftem is found, and where there is a greater proportion of colourlefs fluid, as in a fkate, the flefh is of a white colour, fo that the arteries muft exclude the red globules. If the colourlefs veins terminated in the lymphatic fyftem, we would find the lymphatics of a prodigious number and fize, and the vena cava receiving only the red globules very fmall in proportion to the aorta, but the proportions are the fame as in man. We may therefore apply what we obferve in thefe fifhes to ourfelves, and take it for granted, that the red veins correfpond to the red arteries fo far as concerns the circulation of the blood; and if it is proved that the red veins receive all the circulation of the arteries, we leave abforption only as the office of the lymphatic fyftem, and we have direct proofs to fhow that the valvular lymphatic veffels begin by open mouths at the feveral cavities, and fuck in at their extremities the liquors they convey. The analogy of the lacteal veffels fhow this; we find the fame ftructure of their coats, which are thin, tough, and tranfparent; we find them both crowded with valves; we find them both paffing through glands, which agree perfectly, whether we confider the fhape, colour, and confiftence, or the injected veffels. Thus the mefenteric glands, and

the conglobate glands of the groin and axilla, perfectly agree in every circumſtance. We find the veſſels in a ſimilar way paſſing along the ſurface and paſſing through them; and to carry on the analogy they unite together, ſo that the thoracic duct is the common cava of both ſyſtems. What we obſerve then of their ſtructure and courſe, would lead to ſuppoſe that they agreed as to the manner of their origin, that the lymphatic veſſels begin in the other parts of the body by open mouths, whether on the ſurface, or from the different parts of the cellular ſubſtance, or from the ſeveral cavities of the thorax, abdomen, joints, head, and univerſally. Or let us make the compariſon with the red veins. If the lymphatics and red veins had a ſimilar origin, we ſhould probably find the valves diſpoſed nearly in the ſame manner. We find valves in the red veins only where there are muſcles, becauſe their ſingle purpoſe is to direct the blood to the heart, and theſe valves are conceived as dividing the veſſels into a number of parts, and leſſening the preſſure of the blood upon the deſcending veins; but they have not this effect, for if the blood is juſt now ſtagnating in the veins, and a motion is made, the conſequence is, that the valves are all opened, and the preſſure is the ſame upon the bottom as if the valves had been entire. The preſſure is not leſſened becauſe the liquor is in motion, but increaſed; and it matters

not whether the veins aſcend or deſcend to the heart; the only circumſtance that requires valves is their paſſing along muſcles; ſo we find them in the ſuperior parts, in the head, &c. but ſcarcely within the cavities. But, in the lymphatic veſſels, the valves are found every where, and we obſerve the effect of this is, that the ſlighteſt preſſure upon them drives the fluids outwards beyond the next ſet of valves towards the heart. Thus, if we inject a lymphatic veſſel with mercury, we muſt be cautious how we touch it, for it readily goes onwards, and we cannot again fill the interſtices between the valves that the mercury has left; thus they are fitted to take advantage of the ſlighteſt preſſure or impulſe; every ſtroke of an artery paſſing over them ſerves to drive the blood onwards. Hence, univerſally, the lymphatic ſyſtem is crowded with valves, ſhowing that it wants the ſame preſſure onwards, or the vis a tergo which is found in the other veins; ſo that as they are fitted to take the advantage of every preſſure, they need it to promote their contents.

DXCV.

After an artery is tied up, and the flow from the heart intercepted, the lymphatic continues to be filled. Why? Becauſe it is independent of the artery; and whilſt the life, the warmth, ſenſibility and contraction of the heart continues, the motion in the lymphatic continues, though the

vis a tergo has entirely ceafed. Nay, after the heart is cut out, and the thorax or abdomen laid open, if you empty any veffel by preffure upon it with the finger, it foon fills again, after the motion has ceafed in a remarkable degree in the red veins. The fame thing appears from the colour and appearance of their contents. Thus, in jaundice occafioned by a total obftruction of the biliary ducts, the lymphatic veffels take up the bile almoft as pure and bitter as it is found in the gall bladder, which is a direct proof that the lymphatic veffels in the liver begin from the cavity of the biliary ducts, viz. perform abforption, and fo far as proof is neceffary this may be fufficient.

DXCVI.

But there are other circumftances which it is very material and ufeful in practice to attend to. Where acrid matter, whether of medicine or difeafe, is applied to our body externally or internally, we find, in many inftances, that the matter directly enters the lymphatic veffels, and, before it fhews its influence on the body in general, produces fwellings of the glands, through which the lymph, loaded with medicine or other matter, naturally paffes. Thus it often happens, that blifters produce fwellings in the conglobate glands, not in thofe next which the blifter is applied, or thofe immediately under it; but in thofe fo fituated as to receive the lymphatic veffels from the

part bliſtered, however diſtant, as in the axilla, or inguinal glands, when the bliſter was applied to the hands and feet, and that without any pains ſpreading along the member; and ſurgeons often find that bliſters of the head produce wax kernels of the neck, their ſituation varying according to that of the bliſter. The ſame is obſervable in diſeaſes, as in the plague, perhaps; but, beyond all doubt, in the meaſles, ſmall pox, cancer, and lues venerea.

DXCVII.

This is a clear evidence that the valvular lymphatic veſſels are abſorbents, performing that office; and they do ſo univerſally, becauſe every part of the body, in a diſeaſed ſtate, can produce ſuch ſwellings. And the idea of ſome, that lymphatics are wanting in the brain and ſome other parts, becauſe anatomiſts have not yet injected them, merits a ſerious refutation. Are we to ſuppoſe an exception of one organ from the general analogy of all others? That the whole order, not only of abſorption, but of circulation, is inverted? The only reaſon aſſigned is the difficulty of ſeeing them. We can bring them into view in the abdominal viſcera, but we cannot do this in the brain when the animal is in life. In the brain they terminate in a different manner from what they do in the other parts. There is ſomewhat particular in the courſe of the larger veſſels, in that

they do not accompany the arteries; but we find a number of conglobate glands immediately under the brain, in proportion greater than could be ſuppoſed, unleſs the lymphatics of the brain paſſed through them; and wounds and ſuppurations of the brain have brought on ſwellings of the neck.

DXCVIII.

But, ſuppoſing that the lymphatic ſyſtem does perform abſorption, does it follow that the abſorbents do not likewiſe terminate in the red veſſels; or that abſorption is not performed by thoſe alſo; or while the valvular lymphatic veins abſorb, are we to ſuppoſe that the red veins aſſiſt in the ſame office? It is not conſiſtent with the ſymplicity of nature to make ſuch a ſuppoſition, to ſuppoſe one ſet of veins ſerving the ſimple purpoſe of abſorption; and that the other ſet of veins ſhall not only ſerve that, but likewiſe the purpoſe of circulation. It is more probable, that as the two kinds of veins correſpond to different kinds of arteries, that they correſpond entirely, and that the one office has no connection with the other; but that the red veins ſerve for circulation, and the lymphatics for abſorption.

DXCIX.

If the ſtructure had been fully underſtood before the other ſuppoſitions had been formed, we might have allowed it to have had more weight; but the red veins were known long before the

lymphatics, and therefore were for many ages ſuppoſed to ſerve every purpoſe in the body; and even after the diſcovery of the circulation, they took it for granted, that the red veins ſerved both for motion and abſorption. And it was not eaſy for phyſiologiſts, though they now began to treat matters more minutely, to diveſt themſelves of their prejudices; and inſtead of producing arguments againſt the former opinion, more were advanced in favour of it.

DC.

Thus it has been alleged, that the lymphatic veſſels are wanting in a variety of animals, which in other reſpects agree with man; ſo that abſorption muſt be performed in them by the red veins. But we find that in the oviparous animals there are lymphatic veſſels.

DCI.

There has been alſo alleged the want of lymphatic veins in certain places, becauſe they have not been ſeen, as in the brain and eye, and it has alſo been appealed to injections. An injection is made into a vein, and it is found that ſome cavity is filled, and truly water ſquirted back in the meſenteric vein will be effuſed; but it may have entered the artery, and paſſed by its exhalant branches. And reverſing the experiment, let us pour the water into the cavity of the inteſtines, and ſee if it enters the vein; and if we uſe coloured ſub-

ſtances, or thoſe that have a ſtrong ſmell, and which readily enter the lymphatics, we find that they do not enter the meſenteric veins.

DCII.

Wherever, alſo, a number of the glands have been obſtructed, as in the axilla, the whole arm has become ædematous, and yet the red veins are not affected; and if theſe are provided with numerous abſorbent veſſels, why do not theſe perform their office?

DCIII.

Having then endeavoured to determine the nature of the abſorbent veſſels, let us next conſider the way in which we are to conceive liquor to move in a veſſel that wants the vis a tergo that is not continued from an artery. The lacteals ſuck in their contents, or draw it in, in the manner which the veſſels of vegetables probably do, or in the manner in which very ſmall tubes draw water from a ciſtern, and the liquor only enters at all if it be of a mild nature; and hence we learn that our lacteals poſſeſs a living power, that they ſhut their mouths againſt acrid matter; ſo they poſſeſs motion and contraction to ſuch a degree as to exclude a very thin ſubſtance altogether, providing it is extremely acrid. This helps us to explain the progreſs of the liquor; for, although the water will aſcend in the tube a certain way, yet at length it ſtops; ſo the attraction of capillary tubes only

begins a motion, it is not capable of continuing it, rifing only to a certain height, and then ftagnating. To pufh it on a living power is neceffary; and this beyond all doubt is inherent in the lacteal or lymphatic, from its own coats. And, as a farther proof of its being mufcular, after the death of an animal, when the lacteal veffels are full, after cutting off the head or heart they empty themfelves completely, and pufh on all their contents into the thoracic duct, fo that it is feldom that we can give a demonftration of the lacteal veffels from the colour of their contents. From that it may be prefumed that our veins poffefs a fimilar power, and chiefly in their fmall branches. But befides the power inherent in them, they receive a confiderable affiftance from the preffure of the neighbouring or external parts; and in the inteftines it is beyond doubt, that the mufcular coat of the inteftines alternately contracting and pufhing on the fœces, affects the beginning of the lacteal veins; and when the lacteal itfelf contracts, the valves hinder the liquor from being preffed outwards, fo that every preffure determines the fluid to the heart, as the pulfation of the arteries and the action of the mufcles. Thus, when a vein is opened by acting with the mufcles of the arm, we accelerate the flow of the blood, and we would do fo though there are no more veins in the member, and the lymphatic veffels appear to be

purposely exposed to the action of the arteries, and even swelling of the common red veins, while from their being crowded with valves, they are fitted for taking advantage of the slightest pressure; and the principal trunk of all runs up the thorax parallel to the aorta, so that every stroke of the heart affects it, and pushes forwards the chyle with considerable violence: so we can readily understand the manner in which the liquor enters the absorbent vessels, and is conveyed to the heart.

DCIV.

The principal offices, then, of the absorbent system, or the general purposes that it serves in our body, are various; and the very first use that occurs to us respects the lacteal vessels, that they serve for taking in our nourishment; and what we say of the lacteal vessels even in this view, seems in some measure to apply to the lymphatics. It also prevents the too great accumulation of liquors in the various cavities of the body, unless there was a corresponding absorption to the exhalation into them, every shut sac would soon become dropsical; and, although this was not the case, although they did not supply more than is necessary to make a free motion, yet the liquor by remaining long would become acrid and hurtful, hence the necessity of a constant change; and all the secreted liquors undergo it; so persons grow fat and lean, so the absorbents

can take up from the adipofe follicles the fat of the body, and there is a continual change of the fatty parts, and of all others in the fame manner.

DCV.

We muft alfo fuppofe that many changes are operated on the fecreted liquors, in order to fit them for their feveral purpofes, for we cannot imagine that they come from the arteries with all their properties. Thus, the bile in the gall bladder is much thicker, and materially different from the bile found in the hepatic duct; fo it has undergone a preparation, particularly the abforption of the thinner parts. In like manner the fat is feparated from the exhalant veffels, not of the fame confiftence as it is found in the adipofe plexus, a watery fluid muft have conveyed it there, which is afterwards re-affumed. So in the mucus that is expofed to the air, we find a febaceous or mucous matter in the follicles or bags of the trachea, &c. and this mucus has been alfo changed by abforption. Perhaps we may pufh this one ftep farther, that the abforbent veffels do not merely ferve for the preparation of the fecreted liquor, but that a fomewhat that is ufeful to the œconomy is at the fame time taken away and returned to the mafs of blood; viz. that by the fecretion fuch changes are produced upon the liquors, that when thefe are re-affumed, they have different effects upon the body from the effects

of the principles of the blood. Thus it can be rendered probable that in the jaundice, the yellownefs is not owing to the want of feparation of the bile, but to its being returned to the blood; and if we can prevent the return, we can prevent the difeafe. In the femen, alfo, we obferve that the whole conftitution is affected by it; if this was owing to a want of feparation, the fœtor obferved in the flefh of bulls would be more remarkable in the flefh of oxen.

DCVI.

Perhaps it may be afferted that fomewhat ufeful is taken in from the moft excrementitious liquors, as the urine; for in fifhes there is a vefica urinaria. If all the parts were ufelefs, it might be difcharged from the body by the ureters without any inconvenience to the animal.

DCVII.

We obferve in the laft place, that the lymphatic fyftem is connected with the lacteal, or rather that the veffels defcribed under two names make one fyftem, and the lymph is mixed with the chyle. Indeed, without this dilution and feparation, the mixture with the mafs might have proved hurtful.

DCVIII.

Thus, by this doctrine concerning the lymphatic fyftem, a variety of circumftances are explained. Our views are enlarged by confidering the abforbent veffels as valvular, for we fee more dif-

tinctly the benefit in health, and in disease arising from friction and exercise; whilst the branches of the red veins were considered to perform the office this is less evident; but from the number of valves we cannot rub the body, but we accelerate in a remarkable degree the flow of the lymph, and that will lead to the use of this in a variety of diseases, as in the dropsy, where we are very apt to err in recommending rest and a horizontal posture, which lessens the swellings of the feet, because the erect posture increases exhalation, and makes the return more difficult; but exercise and friction are of particular use.

DCIX.

As the vessels pass through glands before they reach the heart, we find in those a minute division of the vessels, and then an opening into very small cells, in which the liquor for some little time has its motion diminished, is more out of the course of circulation. Hence we conceive that the glands of the lacteals and lymphatic system are much exposed to obstruction, and that this will more readily happen in the lacteal glands, because a greater quantity of acrid matter passes through them.

DCX.

By this division of the lacteal vessels in the glands, the reason appears why, after the breaking of buboes or scrophulous tumours, there is a

considerable discharge of watery matter, the flow of lymph into the gland continuing, which in these cases does not readily enter the vasa egredientia.

DCXI.

By the anastomosis of the lymphatic vessels and lacteals every where, the small branches continually receive an addition from the neighbouring ones; and whilst many pass through the gland, others pass upon the surface, and therefore an obstruction may happen in the first lymphatic glands which a poisonous matter touches upon; but although the same poison be conveyed further, the glands near to the heart are not affected. Thus, with regard to the venereal bubo in the groin, the formation is similar. Not one within the body is met with, which is prevented not merely from the warmth of the part, but especially from the poison being diluted by the joining of the lymphatic branches from the inferior extremities, before the poison reaches the next glands. Keeping the same in view, the reason is afforded, why a stoppage in a single gland does not produce anædema in the vessels from which it is originally derived, a number of the vessels passing over the gland, and carrying on the absorbed fluid towards the heart.

DCXII.

From attending to the cause of the swelling of

thofe glands, a direction is offered in the cure; for, by knowing the caufe of the venereal bubo, we endeavour to direct the mercury into the gland, by applying it as near as poffible into the part receiving the contagion.

DCXIII.

In the fame way we are able to determine the extent of the difeafe in cancer, by the fwelling of the contiguous glands; to judge of the fuperior advantage of the inoculation in fmall pox, from the poifon entering through the external parts.

DCXIV.

Structure of the Glands.

But, on leaving the vafcular ftructure, it remains to examine more particularly the nature of the glands; and, by tracing the beginnings of the feveral ducts, to endeavour to determine whether the arteries communicate with thefe exactly in the fame manner that they communicate with the circulating veins; and thus, that their ducts only differ from veins in this refpect, that the end of the duct does not terminate in the heart, and that the liquor differs from the general mafs; or, whether a receptacle bag, or follicle, be interpofed. Are we to imagine that a branch, which excludes red globules, takes its rife from the artery, and terminates in an excretory duct, or that there is a bag or follicle interpofed, into which the artery pours the liquor.

DCXV.

These are the two common opinions entertained by physiologists. The most antient supposes, that in every excretory duct, at the beginning, there is a follicle; and, in proof of this, it is observed, that there are bags containing slime upon the tongue and in the first passages, and a hole in the side of it. In the amygdalæ there are also several holes which lead to bags of considerable size. Hence the amygdalæ have been compared to a collection of small bags, and the liver and the salivary glands have been supposed to be composed of a number of knots, in each of which there is a bag of the same kind; but from the vast number collected, there seems a necessity that those should not terminate by holes, but there must be long ducts, like the hepatic duct, to convey the liquor. And in morbid bodies, also, vesicles are found in the liver, and also within the kidneys; and those are alleged to contain urine. So it has been conceived, that some one of the follicles of the kidney had been obstructed, and had enlarged, these vesicles shewing the real structure, only in a greater size.

DCXVI.

When the art of injecting was improved, it was pretended that it was unsafe to reason in that manner from the analogy of one organ to that of another; and that, by injection, all the glands

could be changed into veſſels, without leaving any appearance of follicles. It was alleged, that in the kidney the circulation might be imitated, and a coloured liquor made to paſs into the pelvis; and yet, upon examining the kidney, no bags could be ſeen; or that, by injecting the renal artery, the tubulus uriniferus may be filled without any follicle found. A calculation is entered into, that, in the caſe of follicles, there would be an almoſt total ſtagnation of the fluids in the paſſage; that the velocity of the blood would not be 1,200,000 part in one of the follicles that it is in one of the arteries that is ſuppoſed to make the ſecretion. From this it has been inferred, that the glands are merely compoſed of cylindrical veſſels.

DCXVII.

But to fix theſe points, we ſhall be more particular in our inveſtigation of the glandular organs. Beginning with the fatty bags, we obſerve with the microſcope, that the whole fat of animals, not only the marrow, which was ſuppoſed to conſiſt of round fatty bags, but the fat is all divided into bags of a minute ſhape, painted with veſſels, ſo that bags or follicles in that glandular organ are indiſputable. Beſides, all anatomiſts admit of follicles where the air, or ſharp liquors are applied, and a defence is needed, as in all the mucous and lymphatic organs. In theſe follicles the mucus acquires its proper viſcidity, or other properties;

ſo the whole of the tongue is made red with an injection, and the bags of the follicles give it this redneſs, numerous arteries running upon them; and in the paſſage for the urine we find bags of a conſiderable ſize. In our throat, round bags anſwer as well as any other ſhape; but in the urethra they are oblong, and thereby the liquor is better puſhed out at its extremity before the urine comes in contact with it.

DCXVIII.

Next, in the organs of generation, particularly in the ovarium, we perceive a round veſicle filled with a liquor, no doubt of the higheſt importance. This veſicle opens at the time of conception, and it is painted with veſſels, and we find in the male long tubes forming the teſticle, that the ſemen is depoſited into theſe, and the communication of the arteries with the turns of the ſeminal ducts may be compared to the communications between the arteries and ducts of the inteſtines.

DCXIX.

With regard to the more compound glands, the ſtructure of them is more like to the ſhape of a bunch of grapes or currants. All the ducts begin from bags. We ſee with the naked eye this ſtructure in the mamma. We likewiſe obſerve little lobules compoſed of cells on the ſurface of the lungs; and in the ſalivary organs, we know as certainly as with regard to the lungs, that the

ſaliva is depoſited into cells. When the ſalivary gland is properly injected, and expoſed to the microſcope, the appearance is nearly the ſame which the ſurface of the lungs has when expoſed to the naked eye, and every one of the little lobules are diſtinct from one another. The joining, however, of the receptacle with the duct, is very ſtraight, and it is difficult to fill the receptacles of the ſaliva with mercury, generally the duct will burſt before the mercury diſtends the receptacle. With melted wax, which is a more penetrating ſubſtance, we can fill them more readily. In the parotid gland we find ſome little difference in the ſize of the receptacle, and in the manner of communication. In the pancreas, the ſtructure is more complex, and perhaps the ſaliva is not the ſame; but as there is ſome difference of ſtructure, the particular texture may be of greater conſequence than we are aware of.

DCXX.

Next, with regard to the liver, the diviſions are ſo minute in this organ, that it is next to impoſſible to determine the firſt beginning of the biliary ducts, becauſe the lobules are very much intermixed. But as we have it in our power to dilate the ducts, we ſee that the biliary ducts begin likewiſe from very minute bags, ſuch as the naked eye does no ways take in. But ſuppoſe they equal the thouſand part of an inch, ſtill they

are large, compared with the arteries making the ſecretion; for three or four thouſand arteries conveying red globules could be laid in the ſpace of an inch, but an artery circulating red blood is larger than one making the ſecretion, ſuppoſe four times, ſo that the diameter of the ſecreting branches is to the veſicle as one to twenty. And it is eaſier to paſs an injection from the vena portarum into the biliary duct, than the other way.

DCXXI.

With regard to the kidney, the courſe of the fluids may be ſeen through it into the pelvis; but the more we are uſed with microſcopical obſervations, we ſee the more difficulty in determining it exactly.

DCXXII.

Thus it is very evident that all, or almoſt all, the glandular organs have receptacles interſperſed between the arteries making the ſecretion and the excretory ducts.

DCXXIII.

But although we can trace the ſtructure of glands back from the excretory duct to the follicle, we are by nò means able to give an account of the changes that are operating; and even did we know the way in which the arteries communicate with the follicle, we will be ſtill far from underſtanding the changes made upon our blood

by the glands. Thus, we can trace the whole courſe of the red globules of the blood, and yet we cannot ſee how theſe are formed from the food. It is effected by the general circulation; but with regard to the particular manner, we certainly do not comprehend it.

DCXXIV.

In ſpeaking of ſecretion, we muſt include a variety of circumſtances; and, perhaps, after enumerating all that occur to us, others ſtill remain, the effects of which eſcape us. We ſee that the arteries of the glands are placed in very different ſituations with reſpect to diſtance from the heart, and the direction varies greatly; ſome going off at acute, others at right angles. There is, beſides, a great diſproportion in the ſize of the arteries compared with the organs on which they terminate, in their length, &c. We cannot but ſuppoſe that thoſe various circumſtances have great effect. The coats of the arteries are alſo of different thickneſs. In the liver, the ſecretion is made from blood that has undergone a circulation, and the force of which is more broken than in any other part of our body; ſo that long before blood comes near to a gland, or to the ultimate termination, a proper preparation is made for the ſecretion. Beſides the effect of the different angles, we muſt alſo ſuppoſe the activity of the veſſels to have effect; we obſerve that irri-

tation varies the quantity, and even the nature of the glandular liquors; and we are not, with authors, to conceive mechanical changes, as that the glands represent sieves, that the secretion and changes depend upon the ultimate terminations of the vessels. There are also chemical ones going on from the first origin of the branches, as well as in the termination of the arteries in the follicles. By fermentation, we know that the same substance puts on a different nature, and some similar changes take place in the glands. Therefore, though we were able to trace the arteries from their beginning to their termination in the ducts of the glands, we should be unable to explain the changes we observe. We can go so far, but there is a limit beyond which we cannot pass.

DCXXV.

Nervous System.

We next proceed to consider the general office of the nervous system. In beginning which it is necessary to give some general idea of the manner in which some of the more powerful medicines act upon the body of animals; viz. whether they affect them through the nerves only of the part to which the medicine is applied, or whether they operate by entering first the absorbent, and afterwards the circulating system? We are, indeed, variously affected by medicines,

or by the matter of diſeaſe acting upon our body; for, beſides topical medicines, which ſcarcely affect the parts at a diſtance, medicines by reſting merely upon a ſingle nerve, through the nerves alone can affect the whole ſyſtem, or from being circulated they may have this effect, and chiefly upon the nerves of the circulating ſyſtem. Farther, we find that ſome medicines have a topical determination, or one organ is more affected by them than another; all the reſt of the ſyſtem, however, though not primarily, comes to be affected, re-acting on the reſt. Thus, ſuppoſe mercury to enter the heart and veſſels, they feel its influence, the pulſe is affected before it fixes upon any organ, and the venereal poiſon is killed floating in the general maſs; but in conſequence of its attacking a particular organ, all the reſt may come to ſympathize: ſo the operation of medicines fermenting and multiplying in the maſs, may be more complex than is generally apprehended.

DCXXVI.

With thoſe facts we are better able to judge of the nature of the nerves. The manner of their origin and courſe is already known. A nerve is the production of the medullary ſubſtance of the brain, covered nearly with the ſame coats as the brain; an inner vaſcular one, reſembling the pia mater; and an outer ſheath, either the ſame altogether, or very like to the dura mater. This

is found in every part without the head: with the exception of ganglia, the threads of the nerves are laid parallel to each other. By diffection, a very minute divifion of the nerves is feen into threads; but applying the microfcope, that divifion is carried on as far as our fenfes go, efpecially if we truft to the obfervation of Lewenhock, almoft *ad infinitum.* Hence we are led to confider whether the nerves are to be looked upon as folid chords, like wires, acting by tremor; or are we to fuppofe that they are hollow tubes conveying a fluid within them? Or, are we to imagine, perhaps, that whilft they convey a fluid within, they in fome other manner unknown conduct fome other fluid that is ftill more fubtile. But, perhaps, with regard to thefe feveral points, we can only form fome very general conjectures, without being at all able to determine ourfelves.

DCXXVII.

The moft common opinion rejects the idea of folid chords acting merely by vibration, and there are many circumftances which concur againft this notion. We have feen that the nerves are extremely fhort at their origin; if they appear hard in their progrefs, that depends evidently upon their coats. Again, when they come to operate, as in the eye or ear, we perceive that the coats are laid afide; nay, if the nerve is not to be fub-

ject to motion or preffure, as the portio mollis of the auditory nerve, the firm coats are altogether wanting; and we find fo many nerves inclofed in the fame bundle, that we fcarcely have any idea of tremor communicated to one without communicating it to others; we find no determined proportional length and tenfion; on the contrary, tenfion is avoided, branches are tied down, preventing the regular tremor; and what is ftronger than all this, fuch an idea is repugnant to the general analogy of animal bodies. Wherever we perceive fluids circulated, and chords fent out, thefe are tubular; and we obferve that the moft minute thread, the fmalleft nerve taken from one animal, and tied around the nerve of another, fo as to comprefs it, altogether interrupts its influence: fo there is little probability that the nerves, if folid chords, operate by tremor.

DCXXVIII.

On the contrary, there feems to be a great degree of probability, but no abfolute certainty, that they convey a fluid. We can determine nothing from looking at the cut end of a nerve; we can give no credit to thofe who pretend to have feen a fluid diftilling from a nerve, nor are we to reject the idea, becaufe it cannot be feen, fince the nerves divide into parts fo minute and colourlefs, that if they contained a fluid, we could not render that an object of fenfe. We

might as well deny fluids in the body of a mite, becaufe before a microfcope we do not fee the motion of thofe; and the nerves of the eye, for inftance, divide into parts exceedingly minute, far beyond what we could conceive, till we made a calculation, which we can make with tolerable accuracy. If the head of a pin can be diftinguifhed at the diftance of twelve feet, the diameter of the figure upon the retina is as much fmaller than the head of the pin, as the diltance from the pin to the lens is greater than the diftance of the lens from the bottom of the eye. And entering into a calculation in this way, it is eafy to prove that pictures are fometimes formed, the diameter of which does not exceed the 20,000 part of an inch; and probably that picture influences feveral nerves, becaufe we can judge of its parts, that one part is more round than another. Thus, perhaps, in the retina, the nerves are not the 50,000 or 100,000 part of an inch in their diameter, and it is impoffible to perceive their cavities, or the fluid they convey; fo are to judge from probability, or by reafon, upon it, by comparing the brain with other parts, or attending to the phœnomena of the nerves.

DCXXIX.

The brain refembles fome of our glandular organs in its appearance; we may compare it with the kidney. There is a vafcular and cortical fub-

ſtance within that in the brain, what is called medullary ſubſtance, and the ſame name has been applied to the tubular uriniferous part of the kidney; and perhaps the nerves may be compared to the tubuli uriniferi, or at leaſt there is a diſtant reſemblance between theſe organs and all the other organs that have the appearance of blood diſtributed upon them, and that ſend out hollow tubes or ducts.

DCXXX.

Preſſure upon the brain, though not ſo made as to deſtroy its ſubſtance, has been found to bring on convulſions of the muſcles. That, however, is merely a probable argument, that ſomething is ſqueezed out; but it may be occaſioned many ways, as from irritation to a certain degree. But we know that moderate preſſure upon a nerve ſtops its influence, as when we ſit upon the edge of a ſeat the whole leg ſleeps; and, when we remove the preſſure, we feel a ſomewhat get into the member, not without pain; we are almoſt afraid to riſe off the ſeat, as if ſomething had been accumulated, and immediately deſcended into the nerve with more than common violence. Or if a nerve is laid bare, running to a muſcle, then the nerve cut acroſs, the muſcle becomes unactive, but may be rouſed into action by puncturing it; but there is another way, by moderate preſſure upon the nerve. If we preſs it in the

moſt gentle manner, without ſtretching it, we are ſenſible of a motion following, as if we had determined ſomewhat from the nerve down into the muſcle. So that the moſt probable opinion is, that the nerves convey a fluid. Still, however, we are very far from being certain of this, becauſe every circumſtance may admit of ſome other explanation, and is only mentioned as more probable than any other opinion yet formed.

DCXXXI.

How far we are to add to this, that whilſt the nerves convey within them a fluid, they are likewiſe charged with ſome other without them, or in their coats.

DCXXXII.

With theſe obſervations we are led to examine their more particular offices. They ſerve, as has been ſaid, in general, for ſenſe and for motion.

DCXXXIII.

That the two firſt offices are moſt juſtly aſſigned to them, is beyond all reaſonable doubt; for the moſt ſimple arguments prove it. When a nerve is cut, the animal ſuffers no injury, no pain, from irritating the member beyond the inciſion. In like manner the member loſes the living principle of the animal, it loſes all further power over the member, the animal has it not in its power to perform any motion with the muſcles of the part, ſuppoſe the circulation to continue much as before.

DCXXXIV.

But now let us conſider theſe two offices of ſenſe and motion more particularly. Phyſiologiſts, in general, uſe an improper term. Speaking of nerves, they call them the only ſenſible parts, that the nerves only poſſeſs ſenſe. But meaning to define with preciſion, it may be ſaid only, that the nerves are ſo diſpoſed in the body of an animal, as to give to it the ſenſe of injury done to the body. We are not to imagine that we feel pain, but the nerve only gives the idea, or renders the mind of the animal, ſeated near its origin, ſenſible of the injury.

DCXXXV.

It is material to attend to this, becauſe we perceive that, from want of attention, ſome appearances ſurpriſe us, which admit of a ready explanation. If a perſon has had the leg amputated, and you irritate the end of the ſtump, the end of the ſciatic nerve, he feels pain, but not in the thigh or ſtump, but the toes, in that part in which the nerve naturally terminates. And in doing this, he follows not merely a habit, but that ſuch feelings are inherent in our very nature; and if the ſame experiment were performed in the fœtus, it would be attended with the ſame effect. So phyſiologiſts have uſed a term of ſenſorium commune, ſome part about the origin of the nerves, in which feelings are exerciſed.

DCXXXVI.

One great difficulty is to be able to acquire an idea of the manner in which the nervous energy can produce its effects, which leads next to enter upon the nature of this energy, and particularly whether we are to imagine that it is derived in the manner of a fecretion from the veffels of the brain or cerebellum, or that it is of a very different nature, fimilar to the electrical fluid, or to the fluid named ether, or that it is fome fluid very different from this, the properties of which we are perfectly unacquainted with?

DCXXXVII.

Of late years, many ingenious phyfiologifts, from not being able to conceive the manner in which a fecreted, call it a watery fluid, fhould perform fenfe and motion, have adopted the idea of an æthereal matter, or electrical fluid, acting along our nerves. If our nerves of fenfe and motion operate by means of an electrical fluid, or an ætherial, what is the ufe of the brain and cerebellum? If we admit the other idea of fecretion, the ufe is obvious. Are we to compare the brain to an electrical globe exciting this fluid? It is furely by a grofs comparifon. How next does the matter pafs along the nerves? How is it prevented from communicating its influence from one thread to another? Why does it not efcape from the nerves, as the electrical fluid paffes

through the body? So far as they are loaded with a watery fluid, we do not find that they are more capable of conducting ſuch a matter, than any other portion of the body equally wet. If the brain ſome how or other excites this fluid by the blood moving through it, the more a perſon exerciſes himſelf, the leſs he ſhould be fatigued, more of this energy being excited and collected. Or how does a ſlight preſſure upon a nerve ſtop the energy? The preſſure is made with any kind of ſubſtance as with a nerve taken from another animal, and tied round ſo as not to injure its texture, and the energy totally ceaſes. On cutting it through altogether, and replacing the nerves, bring the parts in contact, all influence ceaſes: or ſeparating a member, and allowing time for the eſcaping of ſuch a fluid, we ſtill find the energy remains. Inſtead, therefore, of ſolving the old difficulties, we ſeem to be adding to them; and though it is difficult to conceive how any watery or ſecreted fluid performs the office of nerves, yet it is as well to be conceived when we ſubſtitute ſome other very penetrating and elaſtic fluid. Do we conceive better of the action of the muſcles from a deluge of electrical fluid ruſhing in upon it, or ſome other ſecreted matter? Or do not we ſee that changes equally wonderful are produced by ſecreted fluids: the body is formed, the generation of animals depends upon it, we underſtand

not how, but we cannot deny the fact; ſo, upon the whole, all we can ſay is this, that it is the moſt probable opinion, though far from being a probability next to certainty, that there is a fluid in the nerves; far leſs can we form the moſt diſtant idea of the nature of that fluid, or of the manner in which the mind of animals operates upon it. Nor is it reaſonable to expect that the nature of it ſhould ever be underſtood; if it ſerves to connect the material and immaterial parts together, as we are ignorant of the nature of mind, we ſhall be for ever ignorant of that chain by which mind and body are laid together. Having knowledge, ſo far as experiments will allow, of the nature of the nervous energy; for it is as much a point of ſound philoſophy to know where to ſtop, as to know when to proceed.

DCXXXVIII.

With theſe remarks on their offices, we next trace the nerves from their beginning to their termination, obſerving the uſe of every part. In doing this, their coverings firſt claim our attention. The dura mater defends the brain, and where the nerves are ſent off gives a covering to them, is produced without the head with them, or ſomewhat of the ſame general nature with the dura mater accompanies them in their progreſs, and this is evidently for their defence. That the dura mater in the arm ſerves the ſame

office to the nerve as to the brain within the head. We need no other proof of this, than the compairing the firſt pair with the ſecond. The olfactory entering through holes into the noſe, needs no ſheath; but the ſecond pair paſſing to the bottom of the eye, and expoſed to the action of the muſcles of that organ, needs the ſheath. So, with regard to the ſeventh pair conſiſting of two branches, the portio mollis within the os petroſum wants the ſheath, while the other portion without receives the dura mater. Or, tracing a nerve to its termination, as the optic nerve into the retina, the dura mater is again laid aſide: ſo we are never to connect the office of the nerve with that of this coat.

DCXXXIX.

Next, we meet with a coat of more conſequence, the pia mater, which covers the whole ſurface of the brain, entering into all its convolutions, and from the membrane there are branches plunging into the cortical ſubſtance, and that is connected to the medullary; ſo that we have no inſtance of a cortical matter that does not produce medullary; or we find no medullary ſubſtance that cannot be traced back to cortical. So we conceive that the pia mater is a membrane of the utmoſt conſequence to the brain, though no author has applied what he obſerves with regard to the brain, to the nerves in their progreſs.

Now it would appear that the pia mater, in the whole extent of the nervous ſyſtem, furniſhes to the nerves in their progreſs, what it does to the brain at their origin. For, firſt, we obſerve in the ſpinal marrow a cortical ſubſtance, a cineritious matter. Now, ſurely, the ſpinal marrow very much reſembles any of its branches, dividing farther, ſo we may look upon it as the principal nerve of the body; that, whilſt the chief part is the production of the brain and cerebellum, an addition is made to the nervous energy or matter. And we have reaſon to believe that the caſe is the ſame with every other nerve; that as the ſurface of the ſpinal marrow over the medullary part is cortical, ſo that every nerve is cortical. Compare the whiteneſs of the medullary ſubſtance with the threads of the nerves after they have left the brain, they are of a brown aſhy colour, the threads loſe their whiteneſs, and appear to do ſo after we have ſeparated as much as can be done of the pia mater from them. The want of brain, alſo, in many animals, is natural; and in the human body, where the brain has been wanting, the ſame kind of coats of the nerves have been found, and not very much ſmaller than if the brain had exiſted. Hence we would infer that that power we abſcribe to the brain, may be in part ſupplied by the nerves, we feel only by a ſomewhat about the origin of the nerves, but a

nervous energy roused in the nerve can actuate a muscle. Or let us attend to the effect which stopping the circulation in the vessels that accompany the nerves has. According to the common idea of the nerves being derived from the brain, the stopping the circulation should by no means have the great effect of preventing the nerve from communicating its influence backwards to the rest of the system. If the femoral artery is tied, though we apply opium to the inferior extremity, so as to bring on the want of motion, it is not communicated through the nerve unless the circulation is free along with it: so we shall be tempted to imagine that the use of the pia mater is much more extensive than is supposed, and that this vascular coat serves more important purposes than the merely conveying nourishment to their coats.

DCXL.

Hence the diseases of the nerves may depend more upon topical causes, and be more remedied by medicines confined to the part than we are generally taught to believe. In most affections of the nerves, the disease can be traced to the head, but we may suppose considerable diseases to take place from the want of a due circulation along the nerves in their course or progress. On going deeper, we find the medullary part of the brain every where intimately connected with the cortical. We find, again, that the nerves coming

from the medullary part, are evidently the continuation of its fibres; and we can trace the threads of a nerve a certain way into the medullary ſubſtance of the brain. But we are by no means to conceive that the brain ſerves only to form nerves for ſenſe and motion; there are other latent and important functions performed, we would be inclined to think ſo from obſerving the various directions of the threads in the medullary ſubſtance, from the much greater bulk of the brain than of all the nerves. We find many bundles of medullary fibres directed to oppoſite ſides of the brain, and not to the beginning of the nerves. On comparing different animals together, we find upon the whole that the brain and the degree of ſagacity, vary in ſome kind of regular proportion. In man we find by much the largeſt brain proportioned to the ſize of the body. In the quadruped, the brain is larger than in the bird. In the bird it is larger than in the fiſhes.

DCXLI.

Wherefore functions of which we can give no explanation, are better exerciſed by a certain modification of the brain, or the powers of the mind, by a certain modification of it, ſeem to be expanded. We cannot help drawing a concluſion of this ſort from merely conſidering the more obvious circumſtances.

DCXLII.

In tracing the nerves from their origin to their termination, we are next led to obſerve the effects of connections among them, whether within or without the head.

DCXLIII.

There appears no room for imagining that the office of the brain and cerebellum are eſſentially different; that the one ſerves for the animal, the other for the vital functions. For we find that the *1ſt*, *2d*, and *3d* pairs are derived from the brain, ſo the *4th* and *5th* from the cerebellum; but that the others are derived from the medullary ſubſtance of both intimately united. Next, let us confine our view to the origin of a ſingle nerve: in a few places we can perceive that the nerves are united to both ſides of the brain. This is more particularly remarked of the optic nerves; but in man, as well as in other animals, we can trace them to both ſides; but, if we are to judge from the diſpoſition of moſt of the others, we would ſuppoſe that they take their riſe from one ſide only; yet plain obſervation ſeems to prove, that almoſt all our nerves have a double origin. For if the right ſide of the brain be injured, from Hippocrates down to the preſent time, it has been obſerved that both ſides of the body are affected, and it is difficult to determine which ſide ſuffers the moſt. On taking this in a general way, we

find the origin of our nerves to be more extenſive than at firſt ſight we are apt to ſuſpect.

DCXLIV.

Now, purſuing them from the head and ſpine, in many places they are connected; and, upon the whole, the connections are of three different kinds.

DCXLV.

To begin with the moſt ſimple. In the axillary plexus, or in the nerves that are to ſupply the inferior extremities, there is a joining of two or more nerves into one bundle, the cord they compoſe being equal in ſize to thoſe which enter into it. After they run ſome way, they are again ſeparated, or we ſee new cords formed.

DCXLVI.

Suppoſe, next, that a couple of muſcles are to be ſupplied with nerves, we find a diviſion; and it is in this way that each muſcle receives branches from each of the nerves, or that the firſt nerve ſupplies the firſt and likewiſe the ſecond muſcle, and the ſecond does the ſame.

DCXLVII.

Another kind of connection appears, for example, in the face. We ſee nerves coming out of holes at a great diſtance from each other; and, after ſpreading into threads, theſe are connected together in a way repreſenting the anaſtomoſes of the blood veſſels. Opening the ſheath, the ſame

things ſeem to happen as in the former anaſtomoſis, at leaſt, ſo far as we can judge of minute nerves, there is a croſſing of threads, and no interruption of the threads at their union. The intention of this is, that if by any accident a nerve in its progreſs happens to be cut or compreſſed, all the muſcles in which that nerve terminates may ſtill preſerve ſome ſhare of their power.

DCXLVIII.

But a third kind of connection is by means of ganglia. We find a number of nerves, as theſe between the vertebræ, running together, and where they meet, a great increaſe of bulk, or a knot, is produced; and from the oppoſite ſides of that we find diſtinct threads again ſent off, in ſome inſtances nearly of the ſame ſize; but in others larger than the threads which enter, and more numerous in their appearance; and tracing the threads through them, they change their colour and appearance in every reſpect. The ganglia are redder than the nerves, reſembling the colour of a lymphatic gland; and it is as difficult to ſhow threads running parallel to each other through a ganglion, as to ſhew threads in a conglobate gland, the ſubſtance appears compact: ſo we are much at a loſs to determine the nature and the uſe of ganglia. The threads, indeed, of the ſeveral nerves are here more intimately intermixed than in the former connections, and there may be other latent pur-

poſes which they ſerve, ſuch as have neither been proved or conjectured. Some authors conſider the ganglia as muſcular organs ſerving to puſh on the nervous fluid, whilſt others conſider them as forming an additional nervous influence. Others again ſuppoſe that a more intimate communication is made here, that the fluid is poured out into certain receptacles, and again conveyed to all the branches; and, of late years, it has been aſſerted that the ganglia are interpoſed to intercept the power of our will, and therefore to render certain motions of the body involuntary, ſuch as that of the heart, becauſe it is evidently unſafe to truſt the management of the heart to our diſcretion. But, though this opinion is ſupported with ingenuity, yet many reaſons enforce its rejection. Indeed, the diſtinction made of our actions into voluntary and involuntary, is by no means proper. The action of the muſcles is involuntary; we direct our arm to a certain object, but we have not the direction of our muſcles employed for that purpoſe. Next, the ganglia are not confined to muſcular organs; we have ſeen them in many of the glands, and in many of the muſcles, which are clearly voluntary, and every one of the muſcles of the extremities and trunk of the body is ſupplied with nerves that paſs through ganglia. Beſides, all the ſpinal nerves, before they come to the axillary plexus, paſs through ganglia.

DCXLIX.

But this leads on to a more general point, to determine the caufe of fympathy among our feveral nerves; and the reafon and manner in which the variety of mufcular motions is performed, whether this depends merely on mechanifm, or is directed by a wife agent. In confidering fympathy in the literal fenfe, we find that an injury is transferred from one part of the nervous fyftem to another, or to the whole fyftem. We perceive that if any organ of the body is violently irritated and inflamed, the irritation fpreads more readily to the neighbouring than to the diftant organs, owing to the connection which the hydraulic fyftem has with the nervous, the one acting and reacting upon the other. But we muft likewife admit that if a branch of a nerve be violently irritated, the irritation or inflammation will more readily diforder others confined in the fame fheath than the diftant nerves of the body; and fometimes we meet with plain examples of that kind, though not very frequently. Thus, if a tooth be carious, the irritation extends along the feveral nerves inclofed in the fame fheath with that; and we find if the irritation is in the incifores of the right fide, that that fide will more readily fuffer pain and inflammation than the oppofite fide. Nay, it is evident that there is fome latent mechanical connection of the nerves of one fide of the body

with each other, producing remarkable effects. We fee frequent examples of hemiphlegia, where one fide of the body is affected with palfy, while in the other the mufcular power is preferved, which muft be owing to fome immediate connection the nerves on one fide have about their origin, or in their progrefs.

DCL.

We obferve, alfo, a general connection of all parts of the nervous fyftem with each other. Thus, if we touch the fciatic nerve with a drop of hartfhorn, burning the nerve will not kill the animal, but the flighteft application of this will. So, in the cafe of a bite of a rattle-fnake, from the connection of the nervous fyftem, all the parts fympathize.

DCLI.

But does it follow that the variety of regular motions of our blood depend upon mechanifm, whether from the connection of the nerves in their progrefs, or origin? Or, to explain the queftion, let us fuppofe an irritation applied to a particular organ. Suppofe that the nofe is irritated by any acrid matter, we fneeze in confefequence of that. Now, how are we to account for this action, which is abundantly complex? Are we to fay, as generally has been done, that we can trace the connection from the nerves of the nofe, to thofe that regulate the motions of the

diaphragm and abdominal mufcles, and from that connection are to explain the action following the irritation. Thus, the firft branch of the *5th* pair fends the nafal twig to the nofe, the fecond branch of the fame nerve fupplies the beginning of the great fympathetic or intercoftal nerve, or, running down from the head, is connected to the feveral dorfal nerves, in its paffage along to the phrenic ones, which regulate the diaphragm, &c.

DCLII.

Many arguments occur againft fuch an explanation. We have a fenfe of injury before any action enfues; or, if we are to confider this opinion in a general way, we find many objections arife againft it.

DCLIII.

If a nerve, when irritated, immediately throws into action all others connected with it, when we irritate a nerve of the fore arm for inftance, laying the nerve bare that it may act more readily, it fhould draw the mufcles inwards; but we act with different mufcles pulling the arm away. Or, how comes it that the intermediate mufcles with which the nerve in queftion is perhaps more connected, are free from action? Why do not the feveral mufcles of the face and neck act as violently as thofe of the diaphragm and abdominal mufcles? Or, whence the regularity of their action? Or, why does not an irritation applied

to other nerves, as a wound of the neck, immediately produce ſneezing, in like manner as the irritation of the nerve within the noſe? May not we trace the ſympathy in the reverſe way? Why does not the farther end equally influence the beginning? Or tracing the intercoſtal nerve through the body, the motions are varied according to the place. If the noſe is irritated, we ſneeze; if the throat, we vomit; if the irritation is within the breaſt, or if there is a want of that ſomewhat neceſſary to life, as in over-heated air, our breathing is affected; but where, with the air, an irritating ſubſtance is conveyed into the trachea, we cough; ſo a ſimilar irritation applied to the ſame place, produces a different action. Thus, with regard to the irritation within the abdomen; if it is in the ſtomach, we vomit; if in the guts, purging is excited; if the irritation is in the uterus, there is a certain effort; if it is in the rectum and veſica urinaria, there is an effort of a different nature; and ſurely this variety cannot proceed from mechanical principles.

DCLIV.

On the other hand, the ſame regular motion follows, where we can trace no connection. Do not we act with the iris, though the irritation is applied to the 2*d* pair, at the bottom of the eye? Nay, the two ſides ſympathize; the two eyes move in an uniform manner, which is not

from any connection with the optic nerve. And we are all ſenſible, that almoſt every action or impreſſion firſt influences our mind, the *living principle* is rouſed, and the action follows it; or the imagination, in time of ſleep, performs ſimilar operations where the ſtimulus is abſent. Therefore it is evident, that we cannot aſcribe theſe regular motions to mechaniſm, and muſt give ſome different interpretation of the matter.

DCLV.

In order to do this, let us review the principal actions in a general way, and obſerve the reaſon of the effects. Let us begin with thoſe where the irritation is at a diſtance from the acting organ. If an animal hears a confuſed ſound, he expands the ear, and directs it to the ſonorous ſubſtance, and the motions of the deep parts muſt follow thoſe of the external; or we obſerve the accuracy with which the eye adapts itſelf to light, or with which the two eyes meet to examine the ſame object: or in ſneezing, coughing, &c. we perceive the motion varied according to the kind of irritation and effect which the motion may have in removing it. If a quantity of blood ruſhes into the lungs, no action is ſo fit for allowing it to paſs as inſpiration; or if we have too ſmall a quantity of living principle from the air, or the air is too light, we inſpire more frequently. If an irritating ſubſtance be confined within the trachea, we

cough, which is a very complex action, but the most effectual for throwing out the offending cause if the ftomach is affected, and it is unfafe that the irritating fubftance fhould pafs downwards; it is thrown back by vomiting, and that likewife is a very complex action, performed by means of nerves derived from very different fources; or, if the acrid fubftance gets into the inteftinal canal, the increafed action of that is excited. If the irritation is in the bottom of the canal, befides the increafed action of the coats of the inteftines, we bring into play the preffure of the diaphragm and abdominal mufcles in a regular manner, preffing fteadily, and with confiderable force. The fame thing happens in delivery, and in affifting the bladder of urine to throw out its contents, and to open its mouth.

DCLVI.

If the bladder is irritated, the motion produced is a gradual contraction, different from the action of the inteftinal canal, which plays backwards and forwards, pufhing the food down, bringing it back again, and applying it to the fecerning veffels and abforbents. We have the power over that, though the bladder is fupplied with nerves through ganglia, we can ftop the action of the bladder, or increafe it, at pleafure.

DCLVII.

If we next apply a ftimulus to the mufcles of

our extremities, other mufcles are thrown into action, while the arm is held faft, and the injury kept applied, the mufcle vibrates, as the only way it can free itfelf; and this has led phyfiologifts to talk of mufcles being difpofed to contraction and relaxation. They are in no fhape difpofed to that ftate; do not we fee the contrary in the bladder of urine? They only perform that action which is moft fit. We fee the heart fubjected to an alternate contraction and relaxation, as that kind of motion is moft fit, the heart throws itfelf into its utmoft action in an inftant, becaufe an action approaching to the vis percuffionis is neceffary to drive the blood through the veffels; and the fame contraction in the bladder would have been hurtful, without any purpofe being ferved by them: fo thefe actions are regulated by a wife agent, and it only remains that we determine the agent.

DCLVIII.

In that circumftance authors fail, and their views are greatly limited. An attempt has been made to perfuade us that our mind reafons upon all thefe actions; and after holding confultation with herfelf, determines the manner in which they ought to be performed. Whilft others would perfuade us that thefe actions are dependent upon our mind; but from a neceffity, not from a choice, the heart is ftimulated, and the mind forced to

interpofe; otherwife the heart would be burft, therefore it obeys the ftimulus, and contracts.

DCLIX.

Now it is perfectly clear, that we cannot reafon upon fuch actions, becaufe we want data. We are ignorant of the facts upon which reafoning could proceed. We are not born confcious of our ftructure, and we cannot be faid to do any thing from neceffity which is beyond our power. Let us only take in a few actions, where the operation will be allowed to depend upon fome other principle. An infant, the moment it is born, breathes as regularly and in as proper a manner as an adult. It fucks, and fwallows regularly what it receives into its mouth, and all this upon the firft trial, as well as upon the laft. By what power can that be done? Surely we would fay, by inftinct; and by this we underftand a power that exifted before we exifted. Can we fay that our mind, that we ourfelves poffefs a voluntary power over our mufcles, and yet are nowife confcious of the number, or fituation of thefe. If we were, anatomy would be a needlefs ftudy; but we know nothing of our mufcles; all our power is, that we wifh to move a member in a certain manner, to lay hold of fomething, and we are confcious of that action, and do it readily, but we know nothing of the regulation of the mufcles about it, it is done for us, fo all muf-

cular action is involuntary. Nay, ſhew any muſcle in our body to the moſt able philoſopher; deſire him to act with it, he cannot do it, unleſs you tell him the motion; then he wiſhes to perform that motion, and the action of muſcle follows the wiſh.

DCLX.

So the more we conſider the actions of animals, we find the greater reaſon to conclude, That the *Author* of *Nature*, who made and created them, continues, with *His* unceaſing influence, to operate upon them, not by particular, but general laws, in ſuch a way as is moſt fit to maintain them.

DCLXI.

Anatomical Preparation of the Vaſcular Syſtem.

To exhibit a full view of the vaſcular ſyſtem, a young emaciated ſubject, not exceeding the age of 14, is preferred, and is even preferable if anaſarcous. To prepare for the injection, an inciſion is firſt to be made through the teguments the whole length of the ſternum, equally dividing the bone longitudinally with a ſaw into two. Under the divided bone, a knife is to be introduced on each ſide, ſeparating the mediaſtinum; then by bending back the ſternum and cartilages, the thorax is laid open. The next ſtep is to make an inciſion into the pericardium and left ventricle of the heart, and through the latter a pipe is to be introduced into the aorta aſcendens, and then ſecured by ligature on the veſſel. The body is then to be immerſed in hot water, as directed in other caſes, and the injection conducted

alſo in the ſame manner. The injection being finiſhed, the body is to be laid with the face downwards in cold water to cool the injection as ſoon as poſſible, and keep it equally diffuſed in the veſſels, without ſeparation of its colouring part.

The injection being thus finiſhed, the diſſection next follows, which is conducted by firſt opening the abdomen, continuing for this purpoſe the inciſion from the thorax to the pubes, and then removing the thoracic and abdominal viſcera. The ſtomach and inteſtines are next removed by cutting the meſentery cloſe to the latter, ſo as to leave as much as poſſible of the meſenteric arteries. The liver is next diſſected, leaving as much as poſſible the ramifications of the hepatic artery. In the ſame manner are the kidneys treated, or they may be left to dry, and the ſpleen is removed with the ſtomach. All the veſſels left ſhould be freed as much as poſſible from extraneous ſubſtance, in order to render them diſtinct. The bladder of urine may be inflated, and preſerved whole with the rectum, and its connecting membrane ſhould be removed from the pelvis, ſo as to bring the internal pudendal artery into view. In diſſecting the abdominal viſcera, care ſhould be taken of the ſpermatic arteries from their length and ſlenderneſs. The thoracic viſcera are eaſily removed. The heart, lungs, and æſophagus, are to be entirely removed, and the thoracic veſſels rendered by farther diſſection as conſpicuous as poſſible.

The divided ſternum, in order to ſhow the internal mammary arteries ariſing from the ſubclavians, ſhould be bent back, and to effect this, the cartilages of the ribs ſhould be partly cut on the inſide.

The ſubclavians, carotids, &c. ſhould be made conſpicuous, and their ramifications traced over the head with much time and patience, and no more of the ſkin ſhould be raiſed from any part at a time than is neceſſary to carry on the diſſection, to prevent expoſure of the ſubject to the air and its drying; and in uſing the knife here, the edge ſhould be kept to its inner ſurface.

In tracing the blood veſſels, it ſhould proceed from the large veſſels to their ramifications, and the diſſecting ſciſſars and forceps are the inſtruments uſed after the raiſing the ſkin. The natural ſhape of the cheeks and lips are to be preſerved by filling the mouth with tow or wool. Then the extremities may be diſſected. Firſt, in the arm, after raiſing the ſkin, trace the veſſels from the axilla to the ends of the finger; and in the lower extremities from the groin to the toe. Separate, alſo, and raiſe the muſcles cautiouſly from each other, removing the fat and cellular membrane every where, without removing their attachments, except where the courſe of the veſſels cannot otherwiſe be ſhewn, as on the ſide of the neck, and at the tranſverſe proceſſes of the vertebræ. The pectoral muſcles ſhould alſo be raiſed; the glutæi elevated, or partly removed; and the muſcles of the dorſal and lumbar vertebræ on each ſide ſhould be taken away, in order to facilitate the drying of the ſubject. The brain ſhould alſo be removed through an opening in the cranium, as formerly deſcribed.

The diſſection being then finiſhed, the body is to be ſuſpended in a cool free air by a cord from a hole in the ſummit of the cranium. The muſcles are then to

be ſeparated by the intervention of wool from each other. The thorax and abdomen are to be divided in the ſame manner; and in doing this, regard is ſtill to be had to preſerve their ſituation, and to prevent the appearance of diſtortion. The meſenteric, and other veſſels, are to be placed in proper poſitions. The ſame attention is to be paid to the ſituation of the legs and arms, with the ſame view of ſhewing the veſſels, Thus one hand may be elevated over the head, the palm inclining forwards; the other may hang down perpendicular, with the palm forwards. The inferior extremities are bent in their natural poſition. Much attention is neceſſary to preſerve theſe poſitions during the drying proceſs, and to avoid the putrefaction of any part; which, if appearing, ſhould be waſhed off with ſoap lees, and a painter's bruſh. The preparation once dry, ſhould be immediately varniſhed.

Anatomical Preparation of the Nervous Syſtem.

For this purpoſe a ſmall ſubject is preferred. The diſſection is begun by an inciſion through the ſkin from the lower part of the fore head, over the head to the occiput; and turning down the ſcalp on each ſide with the view of removing a circular piece of the cranium with a ſaw. The brain is then to be taken away, cutting the nerves in removing it cloſe to the organ, and gradually proceeding from the 1*ſt* to the 10*th* pair.

The olfactory, or 1*ſt* pair, being too tender for diſſection, the optic are to be ſhewn by making a ſection to remove the upper part of the orbit. By this ſhould be ſhewn the diſtribution of the branches of the 3*d*, 4*th*, 5*th*, and 6*th* pairs, contained within the orbit. After

14

tracing the remaining branches of the *5th* pair, they follow by the superior and inferior maxillary branches, dividing the lower jaw at its symphysis. The inferior maxillary branches are traced, one to the tongue, and another to the angle of the lower jaw. The *8th* pair is to be prosecuted with the intercostals from the base of the cranium into the thorax and abdomen, carefully dissecting all the branches. The branches of the *9th* and *10th* pairs are readily pursued to the different muscles which admit their ramifications.

In dissecting the spinal nerves, begin with the *1st* pair, and trace its several branches before proceeding to the *2d*; and so in the cervical nerves, the branches which form the phrenic, should be pursued and traced to the diaphragm. On completing the dissection, the subject is to be preserved in spirits.

PART III.

MORBID ANATOMY.

DCLXII.

OUR views have been now ſufficiently directed to the ſtate of the body in health. In this ſtate it is ſeldom preſented to the eye of the phyſician, and it is only under the influence of diſeaſe and derangement it becomes the object of his care. Morbid Anatomy, therefore, or the changes induced on the human ſyſtem by diſeaſe, claim our principal attention, and the former part we have hitherto conſidered, is only uſeful in ſo far as explaining the latter.

DCLXIII.

In explaining this diviſion, it is proper to alter the arrangement formerly obſerved; and inſtead of commencing our inveſtigation with the baſis of the body, we conſider the parts in their order, as more or leſs eſſential to the continuance of life. On this plan we are naturally led to begin with the heart and its appendages.

DCLXIV.

Morbid Change of the Pericardium.

The pericardium, or covering of this organ, we find ſubject to various changes.

DCLXV.

Inflammation.

It is, firſt, liable to inflammation, though not ſo common, and when occurring, chiefly diſplaying itſelf in the adult ſtate. By this attack it is thickened, becomes pulpy and more vaſcular, and upon its inſide there is formed a layer of yellowiſh pulpy matter, eaſily ſeparated. The extent of this layer varies, as alſo its degree of thickneſs. From the pericardium ſmall veſſels ſhoot into it, ſlightly reddening it, and frequently colouring it with ſmall ſpots of florid blood. Projections are alſo thrown out from it at times, forming an appearance reſembling lace-work. The whole of this matter much reſembles coagulable lymph. With this ſtate of the membrane there is accumulated in its cavity a browniſh or yellowiſh fluid. It varies in quantity from a few ounces to more than a pint. It is mixed with looſe pulpy matter, and ſometimes alſo with pus. This fluid reſembles the ſerum. The inflammation of the pericardium is generally communicated more or leſs to the heart.

DCLXVI.

From the layer of coagulable lymph inſpiſſating, a new vaſcular congeries is produced; and by this

congeries a quantity of ſerum is poured out, and afterwards taken up by the abſorbents of the ſame part as the diſeaſe recedes. Pus alſo is diſcharged from the arteries of this part, as there is no other ſource from which it can be readily produced.

Symptoms.

The ſymptoms of pericardial inflammation admit no diſtinction from thoſe of the heart; and that organ always participates in the ſame ſtate when the inflammation is violent. The moſt uſual mark of it is general fever, or increaſed action, accompanied with pain of the heart, which is generally attended with palpitation, irregular pulſe, cough, dyſpnœa, and ſometimes ſyncope.

DCLXVII.

Adheſion.

This membrane is alſo ſubject to adheſion to the heart. Its extent varies from a few points to the whole ſurface, and the adheſion is formed either by a thin membrane, ſuch as the cellular elſewhere, or a ſolid matter like coagulable lymph; and both are very vaſcular. Theſe adheſions are always the effect of a previous inflammation; and the period of its occurrence may be judged of by the degree of adheſion, being looſe in caſes of old date, and firmer in the more recent.

Symptoms.

The ſymptoms of this ſtate are not always

clear, except where the adhesions are close and extensive. They are then marked by oppression and pain in the situation of the heart, an irregular, and at times intermittent pulse, dyspnœa, and dry cough.

DCLXVIII.

Dropsy.

This affection is frequent in advanced life, though it may occur at every age. It is found by itself, but at other times accompanied with dropsy of the other cavities. Its quantity varies from two ounces to more than a pint; and whatever is the extent, no tenseness of the pericardium is displayed, which, perhaps, enlarges with the accumulation. The colour of the fluid is most frequently yellowish, and resembles in its properties the serum.

Symptoms.

Water in the pericardium much resembles the symptoms of hydro-thorax; but the feeling of oppression here is more strictly confined to the situation of the heart, which is also more disturbed in its functions; and this oppression will be also most felt when laid in the horizontal posture, though the two diseases are, for the most part, conjoined.

DCLXIX.

Dryness.

This membrane has been found occasionally like a dried ox's bladder, from a want of the secretion of its natural moisture; but it is a rare occurrence.

Symptoms.

The peculiar ſymptoms that mark this ſtate are perfectly unknown.

DCLXX.

Tumours.

Small tumours have been ſeen growing within the cavity of this membrane. From their containing a white ſoft matter, with a curdled or cheeſy appearance, they have been referred to a ſcrofulous origin.

Symptoms.

Where this appearance occurs, it is generally combined with a diſeaſed ſtate of the lungs; and when the tumours are ſo large as to diſturb the functions of the heart, this diſeaſe will then be diſtinguiſhed by ſimilar ſymptoms as when its diſturbance ariſes from other cauſes.

DCLXXI.

Hardneſs and Oſſification.

The converſion of this membrane into cartilage is only very partial; and, in a ſimilar manner, it is occaſionally changed in certain points into bone, and the latter is more frequent and extenſive in its progreſs than the former. This ſtate has been marked by no peculiar ſymptoms.

DCLXXII.

Defect.

From a defect in the original formation, a want of this membrane has been met with; and,

in that cafe, the heart and its veflels are feen at once completely on opening the thorax. A clofe and uniform adhefion may be miftaken for it, but here the heart and its veflels do not come fo readily into view, and an adhefion prevails at the fame time to the tendinous part of the diaphragm; while, in the former cafe, the heart lies bare in the cavity of the cheft.

DCLXXIII.

Symptoms.

This ftate is attended with no peculiar fymptoms.

DCLXXIV.

Morbid Changes of the Heart.

The morbid affections of the heart may be divided into two kinds, thofe arifing from malconformation or difeafe; and wherever this organ is affected, confequences follow greater than we can explain from mechanifm. The patient has anxiety and oppreffion beyond defcription; a quick pulfe, the confequence of irritation, but it is irregular and intermitting in various degrees; and we are to conceive thofe changes depend upon the fenfibility of the organ, and the fympathy which the body has in general with it, and particularly the nervous fyftem is confiderably irritated.

DCLXXV.

Affections of Malconformation.

The diseases of malconformation are various, according to the particular part where the fault lies. The most frequent affection of this kind depends on a fault of the pulmonic artery; and this again prevents the closing of the foramen ovale. The blood, therefore, does not pass, or but imperfectly, into the lungs; it is merely sent from the one ventricle to the other through the foramen ovale; and in this state, without oxidation, it is transmitted into the aorta. If the blood passes in part into the lungs, life continues some time; but if not, the child generally expires a few hours after birth in convulsive struggles.

DCLXXVI.

The next affection of this kind is the commencement of the aorta over the partition of both ventricles, without its being particular to either, by which an opening or a free passage takes place to both sides of the heart. This conformation is also joined with a narrow or contracted state of the pulmonic artery. Thus the quantity of blood oxidated is merely what passes through this contracted vessel; and when returned to the heart and mixed with the mass, it is barely sufficient for prolonging a miserable existence. By this circulation large coagula of black blood form. The size of the organ becomes considerably

enlarged, while the ſtructure of the lungs decays and ſhrinks.

DCLXXVII.

A third affection of this claſs, is an additional cavity to the heart or middle ventricle, in which the pulmonic artery and aorta both begin; ſo that the right ventricle ſends out no pulmonary artery, and the left ventricle no aorta. By this means, as all the blood is poured into this middle ventricle, only one half goes to the lungs, and the oxidation is therefore incomplete to that extent.

DCLXXVIII.

The ſymptoms of theſe various ſpecies of malconformation are marked by difficult reſpiration, blackneſs of face, which ſoon extends over the reſt of the body; convulſions repeated at intervals, and general palpitation and throbbing of the heart, ſo as to be externally apparent to the eye. When ſome oxidation takes place, and life is protracted, the marks of imperfect oxidation are conſpicuous by the dead or livid unhealthful colour, by the langour and want of motion, by the coldneſs and deficiency of vital heat, which nothing can remove; by occaſional fits, by oppreſſion and anxiety at the heart, by diſtreſſed reſpiration on the ſlighteſt hurry or action, and by the breathing being eaſieſt in the fit, and the child acquiring relief by it.

DCLXXIX.

When the malconformation is in a leſs degree, the marks of this ſtate often do not appear till ſome time after weaning, and when more oxygen than what the lungs can draw in is required for the wants of the ſyſtem. There is always, along with thoſe ſymptoms, marks of imperfect nouriſhment.

DCLXXX.

Diseases of the Heart.

Inflammation.

Inflammation of the heart is rare, except when connected with that of the pericardium, and then the affection of the latter paſſes ſome way into its ſubſtance, which, in that part, becomes more vaſcular, and ſhews ſome marks of bloody extravaſation. Inflammation, however, of the heart itſelf may occur; but it is hardly to be ſuppoſed, as has been alleged, that this organ can paſs into abceſs or ulceration, as death muſt take place long before

Symptoms.

Inflammation of the heart is marked by the ſame train of feelings that diſtinguiſh that of the pericardium. Syncope, however, will be more frequent here than in the former.

DCLXXXI.

Spot.

The ſurface of the heart often exhibits a white opake ſpot at one part, of various ſize, from a ſix-

pence to three times the extent. Its moſt frequent ſituation is the ſurface of the right vetricle, though occaſionally elſewhere. It ſeems an adventitious layer from the pericardium.

Symptoms.

It is of little conſequence, and is therefore not marked by any peculiar ſymptoms.

DCLXXXII.

Polypus.

The next affection, the diſorder termed a polypus, though it is not ſo frequent as many ſeem to conceive, is yet not to be altogether denied, for the blood does coagulate after death without the acceſs of the air; ſo, if a perſon from terror, &c. has fallen into a faint, and continues for ſome time in it, we may conceive a coagulation to have taken place, conſiſting of coagulable lymph filling up ſome of the cavities, and extending to the large veſſels, which is perhaps not to be removed, by the ſucceeding action of the heart; and where after diſſection nothing is found but a very firm coagulum within the heart, this could not have happened *in articulo mortis*, and we may conceive that it happens here as in the caſe of aneuriſm.

Symptoms.

We judge of this by the cauſe, and by finding that the perſon in certain poſtures is more uneaſy than in others, for the polypus may be ſituated ſo

as to cover the mouth of the ventricle, and may be removed by poſture.

DCLXXXIII.

Enlargement.

The enlargement of the heart, for the moſt part, depends upon the oſſification of the valves, particularly thoſe of the aorta. This part is more ſubject to preſſure, and therefore to this accident; for the blood is thrown through a narrow paſſage with violence, and the artery re-acting, the valves are ſhut; ſo they are ſubject to preſſure both from the heart and arteries, and in moſt people put to hard labour, we find an oſſification about the mouth of the aorta, and this diſeaſe in the human body is much more frequent than is commonly imagined. Its termination is ſudden, for ſuch perſons die ſuddenly.

Symptoms.

The manner of diſtinguiſhing the diſeaſe is this: The patient feels anxiety, oppreſſion, the pulſe is irregular, generally intermittent, and for the moſt part weak. He complains much of heat about the breaſt, and perhaps this may be ſome times real, but often it is a mere deception; and the motion of the heart and of the lungs do not go on in the uſual manner. Sometimes he complains of heat in the reſt of the body; but generally, to a perſon feeling the limbs, there is an evident ſenſe of coldneſs, and often the patient complains

of coldnefs in the extremities. If he makes any attempt to walk up hill, he is quickly obliged to ftop, foon becomes extremely oppreffed, and feeling the pulfe, it is irregular at that time. But the diftinguifhing pathognomonick fign is, that the heart ftrikes the fide lower than the common place. It has been obferved that the point of the ventricle ftrikes the thorax as low as the *9th* rib; and if, upon laying the patient on the left fide, we find the ftroke under the *7th* rib, we may be certain that there is a confiderable dilatation. This depends upon the conftriction of the orifice, and we may in fome meafure form an opinion of the degree of that. Some patients live much longer under the complaint than others, and in a manner we cannot account for. Upon applying the hand to the fide, we feel a great many more ftrokes given to it than we find given to the finger applied to the pulfe. Upon making the experiment, 120, or 130, may be reckoned, when it is impoffible to reckon above 86, or 90 ftrokes of the pulfe, many of the ftrokes being fo weak that they were foon loft.

DCLXXXIV.

Offification of the Semilunar Valves.

The moft common offification about the heart is that of the femilunar valves, depending on the depofition of a bony or earthy matter from the fmall nourifhing arteries. But without offifica-

tion, they are alſo found conſiderably thickened, and white and opake in colour, and the neighbouring arteries partake likewiſe in a certain degree in the ſame ſtate. This thickening is ſometimes attended with a rupture, though it is a rare occurrence.

DCLXXXV.

Oſſification of the Auricular and Ventricular Valves.

Theſe valves are liable to aſſume the ſame morbid ſtate as the former; but by no means ſo frequently as the former, from their belonging more to parts of a venous nature. As well as ſuffering oſſification, they are alſo ſubject to a thickening and opacity, and which is extended to the chordæ tendineæ, and lining of the ventricle. Even inflammation of thoſe parts occurs at times.

DCLXXXVI.

But an enlargement of the heart is apt to occur without any particular organic cauſe. In this caſe the muſcular cavities are often not thick in proportion to the increaſe of ſize. The heart is generally found filled with blood, partly formed into a looſe concretion.

Symptoms.

The marks of this morbid ſtate are frequent palpitations, ſo ſtrong as to be perceived by the eye without the clothes. In general, the pulſe is feeble and irregular. At times there prevails dyſpnæa, with a purpleiſh hue of the cheeks and

lips, which varies in deepneſs according to the degree of dyſpnæa. Rheumatiſm has been ſtated as a cauſe of this affection.

DCLXXXVII.

Aneuriſm.

This organ has at times become aneuriſmal, part of it dilating into a pouch filled with coagulated blood, and lined with a thick white opake membrane. This depends on a weakening of the muſcular fibres in the part which yields to the impulſe of the circulation. But the moſt frequent ſeat of this diſeaſe is at the arch of the aorta, which becomes much enlarged, forming either a uniform tumor, or ſmaller ſwellings ariſe out of the large one. This tumor is filled more or leſs with coagulated blood, diſpoſed in concentric laminæ, and the coats of the artery preſerve a proportional thickneſs to its enlargement, a new depoſition gradually taking place by the action of their ſmall veſſels. The coats of the artery are accordingly here more diviſible into layers, occaſionally diſplaying in them ſpots of bony matter, often of a yellowiſh colour. In the neighbourhood of the diſeaſe, the arterial coats differ in their thinneſs and thickneſs at different places, and always bear more or leſs marks of diſeaſe.

The diſeaſe ſometimes terminates by a rupture and effuſion into the pericardium at once, but more frequently it is ſlow in its progreſs, and the

ſwelling gradually increaſing, it preſſes at laſt againſt the ſternum and ribs, a portion of which becomes abſorbed, and the tumor appears externally. In this manner it attains at laſt the ſize of a child's head at birth, and the ſkin loſing entirely its vitality and cracking, part of the coagulated blood is forced out, and the patient is either inſtantaneouſly cut off; or if it is ſlower, ſinks gradually under the diſcharge.

The arch of the aorta, from its curvature, is more particularly the ſeat of aneuriſm, as the blood preſſes againſt it with full impetus, and it occurs often in men, but rarely in women, whoſe arterial ſyſtem ſeems leſs ſubject to diſeaſe.

Symptoms.

In its early ſtage, this affection is marked by a ſtrong pulſation felt in the cheſt, viſible to the eye on the thorax being expoſed. The pulſe at the wriſt is ſometimes irregular, dyſpnœa on exerciſe always attends, and that in proportion to the progreſs of the diſeaſe. But the moſt certain ſymptom is the appearance of an external tumor, with ſtrong pulſation.

DCLXXXVIII.

Rupture.

Rupture of the heart ſometimes occurs, and chiefly to men in advanced life. The blood eſcaping into the pericardium, death immediately enſues. It is the conſequence of exertion at the

time, and ſome part of the organ being thin. Without rupture blood has been accumulated in the pericardium to a conſiderable quantity, and this muſt have been ſupplied either by the coronary or pericardial veſſels.

Symptoms.

The ſymptoms of blood effuſed gradually into the pericardium are great faintneſs, dyſpnœa, conſiderable anxiety and oppreſſion, with dull pain, and weight behind the ſternum. Theſe ſymptoms are ſucceeded by cold clammy ſweats.

DCLXXXIX.

Hydatids, &c.

Hydatids have been found, though a rare occurence, adhering to the heart, and a part of the organ has been alſo converted into bone, and earthy depoſitions form in its muſcular fibres, which are rare phenomena.

Symptoms.

In the firſt caſe, the ſymptoms will be the ſame with thoſe of water collected in the pericardium, with particular tendency to fainting.

In the latter caſe, palpitation of the heart and dyſpnœa have been the leading marks.

DCXC.

Diſeaſed Arteries.

After the heart, ſome obſervations occur on the affections of the arteries, particularly aneuriſm, as not being confined entirely to the arch of the

aorta. From the ſtructure of the arteries, beſides accidents ariſing from wounds, we may conceive that they may be dilated or ruptured; or we conceive a dilatation taking place in a certain degree, and a rupture afterwards, ſome ſudden violence producing a laceration of their coats. So aneuriſm is divided into two kinds, where the whole, or where only a few of the coats are ruptured or cut, and this rupture may be occaſioned by an effort of the artery: ſo, by blowing in air, the firſt coat has been burſt, and the reſt yielding, a ſack was formed, and it is ſeldom that all their coats are found dilated; for it generally happens in one part only, which comes to be ſo much diſeaſed, that it is impoſſible to ſay what particular part is affected; for as to the marks that have been propoſed, that the branches of the arch of the aorta will be found at a great diſtance, that would have more readily happened if the other coats had been corroded: ſo we may ſuppoſe all the coats dilated, or we may ſuppoſe that all the coats ſhall ſuddenly give way, that by a ſudden effort of the ventricle the aorta may burſt, even though it is not previouſly diſeaſed; or, after the dilatation is advanced a certain way, the coats may be conſumed by preſſing againſt ſome hard and reſiſting ſubſtance, in conſequence of which a rupture will readily take place. Thus, in ſome caſes, the ſternum has been ſplit from the top, and has come

to be opened the whole way down, ſo that the aneuriſmal ſac has been ſituated juſt where the arch of the aorta paſſes over the left branch of the trachea.

DCXCI.

The cauſes of aneuriſms are various, and a number of circumſtances may be ſuppoſed to occur. Nay, we ſhall find aneuriſms where it is impoſſible to give any explanation of the cauſe: no cauſe can be aſſigned for the various dilatations which occur in different parts of the body. The arteries are ſubject to a certain rupture, and we may ſuppoſe that we underſtand how this may be occaſioned, by the violent action of the heart; but how are we to explain a circumſtance of the heart itſelf, that it is found to give way even in its thickeſt places?

DCXCII.

Of this we are apt to overlook the real cauſe, to conceive ſomewhat impelling the blood with force, ſo as to occaſion the rupture; and therefore that it is done from preſſure. Ruptures have happened in that way. Thus, the right auricle is filled with blood, and if the patient makes a violent effort in expiration, and bends the body; perhaps, at the ſame time, the expiratory organs and other muſcles will preſs with ſuch force upon the auricle, that the parts of it may give way; but, in other inſtances, we muſt ſuppoſe an exer-

tion of its own fibres to produce the laceration; for not merely the tendons of the muscles may be lacerated by a sudden effort, but the muscles themselves. Thus, the calf of the leg is known to be lacerated from a person's making too great an exertion with the muscle; and we must account for the laceration of the heart in the same manner. Nay, we cannot account for the dilatation of the heart in every part, from an affection in the beginning of the aorta. It is not the force of the blood running in from the veins that occasions the dilatation; the only cause is the action of the heart itself, which, by endeavouring to make itself smaller, is increased. This may seem paradoxical; but the more it is considered, it will appear more evident, for the heart makes a violent effort to throw out the blood, which is repeated in proportion to the resistance that it meets with; and hence the quickness of the pulse in feverish disorders. By the effort, the fibres are distracted; there is an endeavour of these to shorten; but, when the effort ceases, they in reality become longer than before. Thus the particles of the fibres are drawn asunder, and the void is gradually filled up, till the heart is by degrees dilated, and we find little loss of substance, but the thickness seems to increase in proportion to the dilatation.

DCXCIII.

There is some danger of mistaking tumours of the aorta for tumours of another kind, or of mistaking those for tumours of the aorta; for sometimes the artery does not enlarge equally, but a part of the blood stagnates out of the course of the circulation, coagulates, and gives such a degree of firmness, that we can easily distinguish the pulsation; and, on the other hand, sometimes tumours of another nature, whether containing a fluid, or composed of solid matter, happen to form near an artery, and have the stroke of the artery communicated to them.

DCXCIV.

DISEASES OF THE PLEURA.

Inflammation.

The investing membrane of the thorax, or pleura, is the frequent seat of inflammation, especially on attaining the adult state, and it is more so than that of any membrane lining a cavity which has no external opening. Hence, marks of inflammation are conspicuous here on almost opening every subject. It is marked by its thickened pulpy state, its vascular appearance, and its surface covered by coagulable lymph of various thickness, sometimes smooth, sometimes reticulated like lace-work, and attended with an effusion of serum into the thorax. This coagulable lymph is the medium of adhesion, being formed between

the lungs and thorax; and it may be traced in its progrefs from the ftate of lymph till vafcular, and formed into cellular membrane. The inflammation of the pleura of the lungs is frequently extended to the organ.

Symptoms.

The fymptoms of pleurify are general fever, with acute pain in the lateral part of the cheft, increafed by infpiration, dyfpnœa, cough, and difficult recumbence on the affected fide.

DCXCV.

Adhefion.

One of the moft frequent morbid appearances on opening the thorax, is adhefion between the containing pleura and its layer on the lungs, without any exifting marks of inflammation. Being moftly partial, their moft common feat is the upper pofterior part of the cheft, though they at times extend over the whole cavity. The connection they form is of two kinds, either by a clofe adhefion of firm thick membrane, or of a loofe complex layer of cellular matter. Such adhefions muft always be the effect of previous inflammation.

Symptoms.

It is only when the adhefions are firm and fhort, fo as to confine the expanfion of the lungs, that this ftate is marked by external fymptoms. Thefe are difficult refpiration, cough, and an attending fever.

DCXCVI.

Empyema.

The accumulation of pus in the cavity of the cheſt, forms empyema; and it ariſes either from the veſſels of the pleura under inflammation forming pus, or from an abceſs in the lungs burſting into the thoracic cavity. Pus may be formed in the pleura without ulceration, in conſequence of the excretion of coagulable lymph on the ſurface; and it may either fill the whole cavity; or, in conſequence of adheſions, be circumſcribed to a certain part.

Pus alſo from an abceſs in the lungs, is almoſt always circumſcribed in its extent by the previous adheſions formed; though not in general can an external fullneſs be perceived on the ſide where the accumulation is, and even a ſenſible ſwelling perceptible to the feel. Ulceration has, at times, likewiſe occurred in ſome of the intercoſtal ſpaces, and matter from it is ſeen diſcharged outwardly.

Symptoms.

The ſymptoms of empyema are previous inflammation of the pleura or lungs, on the remiſſion of which rigors take place, with an abatement of pain. Cough, and dyſpnæa ſtill continue, and an eaſier recumbence is allowed on the diſeaſed ſide. Sometimes external enlargement gives farther evidence of the morbid ſtate.

DCXCVII.

Hydro-thorax.

A watery fluid in one or both thoracic cavities constitutes hydro-thorax. It is generally attended with the same state of the other cavities, especially of the pericardium and lower extremities. The fluid contained here is of a brown or yellowish colour, with an occasional reddish tinge. In its general properties it resembles the serum, varying occasionally both in its nature and extent, from some ounces to an equal number of quarts. From the latter quantity, the accumulation appears externally on one side by the apparent fullness. The effect of it is a greater or less compression of the lungs, so that one side of them is found at times larger than the closed fist. Water also often accompanies adhesion, marking the presence of former inflammation.

Symptoms.

The marks of hydro-thorax, in its advanced stage, are pretty clear. Difficult breathing, and no rest, without elevation of the superior parts of the body, are leading ones. Suddenly interrupted sleep, with alarming dreams, retention of urine, and œdema of the extremities also attend. The pulse commonly, though not always, is irregular. Sallowness of colour, and a purple hue of the lips and cheeks, are conspicuous, as marking the compression of the organ, and imperfect oxidation of its circulation.

DCXCVIII.

Deficient Secretion.

The natural internal moiſture on the ſurface of the pleura is ſometimes found wanting, or in ſuch quantity, that it appears almoſt dry.

Symptoms.

This ſtate is marked by no peculiar ſymptoms.

DCXCIX.

Oſſification.

An occaſional point, or thin plate of bone, more or leſs extenſive, is found in the pleura, from its veſſels taking on the particular diſpoſition favourable to the formation of this matter. This appearance is common to all membranes, but more to the pleura than to any other; and unleſs forming ſharp proceſſes, or very extenſive, this change cannot be attended with much inconvenience.

Symptoms.

Where this affection is extenſive, the ſymptom of difficult breathing will ariſe from want of full expanſion of the lungs, or free movement of the ribs.

DCC.

Diseases of the Lungs.

Inflammation.

Inflammation of the lungs and pleura are conjoined. By inflammation the ſpongy ſtructure of this organ is more reddened, partly of a florid,

and partly of a dark red hue. An extravaſation of coagulable lymph, and occaſionally of blood, takes place into the ſubſtance of the lungs. With this morbid change their ſpecific gravity is increaſed, they ſink in water, and feel ſolid to the preſſure of the finger, in proportion to the degree of inflammation. The pleura diſplays alſo an increaſed vaſcular appearance, with a layer of coagulable lymph covering its ſurface. The inflammation of the lungs differs from their extravaſation after death, by the want of increaſed vaſcularity, or marks of inflammation of the pleura, and by the colour of the lungs being of an uniform dark ſhade, without any floridneſs.

Symptoms.

The ſymptoms of inflamed lungs are much the ſame with thoſe of pleuriſy, only the pain is leſs acute, and the pulſe not ſo hard. There is here difficult reſpiration, accumulation in the veins of the neck, face ſwelled, and a purpleiſh hue of the lips and cheeks. On ſuppuration taking place, rigors occur, with diminution of pain, and expectoration of pus.

DCCI.

Abſceſs.

Abſceſs is a common appearance in the lungs, conſiſting either of ſmall cavities containing pus, or at other times of large ones, deſtroying almoſt their whole ſtructure. Theſe cavities either communi-

cate alone with branches of the trachea, or opening into the thoracic cavity, pour out their contents ſo as to form empyema. Deep ſeated abſceſſes occaſion the pleura to be little affected, but in the ſuperficial ones it aſſumes inflammation. The texture of the lungs is rendered more ſolid in the neighbourhood of abſceſſes, but in ſcrofulous caſes this does not take place, as commonly appears in ſmall abſceſſes. In the vicinity of an abſceſs the pulmonary veſſels are much contracted, and their extremities, before re-uniting, are almoſt entirely cloſed or filled with coagulated blood, as an effort of nature to prevent hemorrhage.

Symptoms.

The ſymptoms are here the ſame as deſcribed in the termination of the pulmonary inflammation.

DCCII.

Tubercles.

Tubercles are the moſt frequent morbid appearance in the lungs, and conſiſt of round firm white bodies, interſperſed through its ſubſtance. Their ſeat is the cellular ſubſtance that connects the air veſſels. Their ſize at firſt is not larger than a pin head accumulated in cluſters, which paſs into one larger one, and the ſmalleſt tubercle is not below the ſize of a garden pea, though admitting a great variety. Their adheſion is cloſe to the lungs, without any peculiar covering or increaſed vaſcularity. When cut into, their ſtruc-

ture difplays a white, fmooth, firm fubftance, containing in a part of it a thick curdy pus; and in its farther progrefs, by the increafe of fluid, a white capfule comes only to be left, forming a covering to this fluid.

The connection of feveral tubercles always tends to the formation of pus. The appearance and confiftence of the pus is regulated by its quantity, being thick when fmall, but thin when in large proportion. On diffection, feveral tubercles are often found advanced to the ftate of fuppuration, while the interftices of the pulmonary fubftance near them difplays a hard firm texture, and an obliteration of cells. Where fmall abfceffes occur, the difeafe is evidently fcrofulous, and exhibits a thick pus. The converfion of tubercles into abfcefs forms phthifis pulmonalis, and tubercles are formed in every period of life, though moft frequently before the completion of growth. They are alfo frequently produced in the advance of life.

Different from tubercles, on diffection of the lungs, part of their fubftance is found changed into a foft whitifh matter, of a femifluid confiftence, refembling an imperfect fuppuration; and, while the tubercle is circumfcribed, this ftate is more diffufed through the cellular fubftance.

Another variety of tubercle is alfo occafionally confpicuous, confifting of a light brown, fmooth

ſubſtance on the ſurface of the lungs, equalling a gooſeberry in ſize, without any capſule, or appearance of matter formed; and ſometimes they are even much ſmaller, and extenſively diſperſed. The peculiar morbid proceſs forming them is uncertain.

Symptoms.

Incipient tubercles are marked by a ſlight cough, occaſional dyſpnæa, and a ſomewhat quickened pulſe, ſymptoms frequently overlooked for a long time. In the progreſs to ſuppuration, there appears an expectoration of thick pus, occaſionally mixed with blood, gradually producing emaciation, debility, and hectic fever, with its concomitant ſymptoms.

DCCIII.

Water.

From an accumulation of the aqueous moiſture naturally intended to facilitate the eaſy motion of one part of the lungs upon another, diſeaſe ariſes, forming what may be properly termed anaſarca of the lungs. In proportion to this accumulation of water in the the cellular membrane, a compreſſion of the air cells will take place, and an imperfect oxidation of the blood from the deficient quantity of air will ariſe as a conſequence.

Symptoms.

Where water exiſts in this ſituation, the uſual ſymptoms of dyſpnæa and cough will attend; but

the ſame accumulation will alſo ſhew itſelf in other parts of the body.

DCCIV.

Air.

External Accumulation.

Rupture of the membrane of the lungs may take place occaſionally, and the air may be effuſed into the thorax, though this happens but ſeldom, becauſe the outer membrane is not put to the full ſtretch when the lungs are diſtended, and the containing parts give it a ſupport. When it happens, the diaphragm is found convex, and, on opening the thorax, a great blaſt of air will be found to iſſue out. The lungs of that ſide appear compreſſed and ſqueezed, at the top of the thorax, to no bigger a ſize than that of one's fiſt, and they are almoſt as hard as any other of the ſolid viſcera, without the probability of inflating them, by blowing in air from the trachea.

Symptoms.

The ſymptoms here are, ſharp pain of the ſide ſucceeding a violent fit of coughing, followed by difficulty of breathing and ſwelling of the ſide, often diffuſed over the whole body, where the pleura is joined in the accident, and the rupture extends through it.

DCCV.

Internal Accumulation.

Diſtenſion of the lungs with air is a common

appearance on opening the thorax, no collapſe of them taking place, and their ſurface being covered with numerous white veſicles. In this caſe the branches of the trachea are alſo found gorged with mucus.

DCCVI.

Enlargement of the Air Cells.

An enlargement of the cells of the lungs is an occaſional appearance, from the difficult egreſs of their contents, and the rupture, perhaps, of two or three into one larger cavity.

Symptoms.

The marks of enlarged air cells are long difficulty of breathing, but no farther diſcrimination has been made from external ſymptoms of this peculiar morbid ſtate.

DCCVII.

Preternatural Formation of the Air Cells.

Such cells are ſeen at times attached to the edge of the lungs, without communication with the ſtructure of the organ; and they are certainly a morbid growth, receiving their air from the veſſels that ramify upon them.

Symptoms.

No peculiar ſymptoms characterize this morbid appearance.

DCCVIII.

Hepatic Appearance of the Liver and Lungs.

The lungs are often ſeen converted into a ſolid

ſubſtance, of the ſame general appearance and ſolidity as the liver. It is the effect of ſudden and large extravaſation of coagulable lymph into their ſubſtance. In conſequence of this, from the degree of compreſſion, a total interruption of their office muſt enſue.

Symptoms.

This ſtate is marked by violent inflammation, and the ſudden fatality of the attack.

DCCIX.

Earthy Concretions.

The appearance of earth in the lungs, though rare, has at times been met with. The maſſes formed by it are generally very ſmall. Part of the lungs has even been converted into this ſubſtance.

Symptoms.

Along with difficult reſpiration and cough ſome of this earthy matter is brought up, which ſhews the peculiar morbid ſtate.

DCCX.

Hydatids.

Hydatids of the lungs are an occaſional morbid appearance, ſimilar to hydatids in other ſituations.

Symptoms.

The attendants of this ſtate are dyſpnæa, and frequent cough. Being forced up by violent coughing, their appearance characterizes the diſeaſe.

DCCXI.

Diseased Appearances of the Trachea and its Appendages.

Thyroid Gland.

Inflammation of the thyroid gland is a rare occurrence. It does, however, at times take place, and an increafed vafcularity of its fubftance, and extravafation of coagulable lymph both increafing its ufual fize and firmnefs, is a natural confequence of this affection.

Symptoms.

Inflammation here may be known by the increafe of fize, by a fenfe of pain in the part, felt more fevere on preffure or fwallowing, and it is chiefly diftinguifhed from other affections here by the rapidity of its progrefs.

DCCXII.

Bronchocele.

The moft frequent affection of this gland is its chronic fwelling, named bronchocele. It appears a hereditary diftemper, more common to women than men, and confined chiefly to certain countries or diftricts. This fwelling often enlarges to a prodigious fize, with an irregular growth, projecting anteriorly upon the neck. This is particularly remarkable in Savoy. A fection of the gland in this morbid ftate fhews a number of cells formed, containing a vifcid tranfparent fluid. The fize of thefe cells is various in different cafes, but

moſt of them are under that of a pea. This viſcid fluid becomes changed by ſtagnation into a jelly. Thus a morbid and increaſed ſecretion of the gland is the cauſe of the diſeaſe.

Symptoms.

Bronchocele is particularly diſtinguiſhed by its ſlow growth, by the particular ſize to which it is capable of ariſing, by its want of pain, by its occurrence in early life, by the firm ſenſation it yields to the touch, and by its having no influence on the general health.

DCCXIII.

Schirrus of the Thyroid Gland.

The thyroid gland is the ſeat, at times, of ſchirrus, by which it enlarges in ſize to ſome extent, being alſo hard to the feel. On cutting into it, this conſiſts of a ſolid whitiſh brown ſubſtance, with little appearance of cellular ſtructure. It is often produced by ulceration of the æſophagus, particularly at its upper end, extending to the gland, though it occurs alſo without this affection extending to it.

Symptoms.

Schirrus here is diſtinguiſhed by its degree of hardneſs, attended with occaſional darting pain by its leſſer ſize than in bronchocele, and by the advanced period of life at which its attack is made.

DCCXIV.

Oſſification of the Thyroid Gland.

The converſion of this gland into oſſeous matter is generally partial. It takes place only in very old people, and is a rare diſeaſe. No particular conſequences therefore follow this morbid ſtate, unleſs it ſhould prove ſo large as to communicate irritation to the larynx or trachea.

Symptoms.

This ſtate of the gland can only be known by accurate examination. If external, it will be eaſily aſcertained. If more internal, its nature muſt remain ſomewhat doubtful.

DCCXV.

Oſſification of the Laryngeal Cartilages.

This is an affection met with from the middle to an advanced period of life. It is connected with the former affection, and the bony diſpoſition of the gland extends in its progreſs to the larynx. Aſſuming the nature of bone, the cartilages are liable to its changes, ſuffering exfoliation, and being thrown out by an effort of coughing; but this proceſs of exfoliation is extremely rare, though it has been known to occur.

Symptoms.

The chief marks of this ſtate are denoted by the change of the voice, which becomes either rough and hoarſe, or changed into a whiſper from the want of pliancy in the organ. The ligaments

remain in their natural ſtate; but by this change the power of ſwallowing becomes loſt, and death enſues from this cauſe.

DCCXVI.

Ulceration of the Larynx.

The inflammation of the larynx is apt to terminate in ſuppuration, and the ſeat of the latter is the ſacculi laryngis. Ulceration becomes a conſequence, which ſhews, by the thickening of the ſurrounding parts, a ſcrofulous diſpoſition.

Symptoms.

The ſymptoms of this affection are fixed pain in the ſituation of the larynx, dyſpnæa, change of voice, and ſymptomatic fever.

DCCXVII.

Inflammation of the Trachea.

This ſtate is marked by its increaſed vaſcularity, and its changing its natural white pulpy appearance. The conſequence of this is an increaſed ſecretion, as its cavity is filled with mucous fluid, occaſionally with pus, both fluids containing globules of air. This is its ſituation in cattarrh; and in the advanced ſtages of conſumption, along with hoarſeneſs, from a ſimilar ſtate of the larynx, and ſoreneſs along the trachea.

Symptoms.

The general ſymptoms of cattarrh mark this ſtate; and when the ſoreneſs extends down the middle of the cheſt, the inner tracheal membrane

is inflamed. The fubfiding of the inflammation does not for fome time remove the increafed fecretion. The inflammation in confumptive cafes is chronic, and long continued.

DCCXVIII.

Morbid Lining of the Trachea.

In fome few difeafes there is an appearance of a yellowifh and pulpy matter, which is fuppofed to be owing to an increafed quantity of mucus, and that dried upon the trachea, and which appears in the form of a membrane. But it is doubtful whether it is owing to mucus, or we are rather to confider it as a cruft formed by an inflammatory exudation, juft as in the peritonæum or pleura there is difcharged a liquor which gradually infpiffates and forms a cruft of the lymphatic part of the blood; and upon expofing the blood in the trachea to ardent fpirits, it gets a confiderable degree of hardnefs, while we do not obferve fo great a change produced upon mucus by fuch an addition.

In fome of thefe difeafes, a few authors have confidered the cruft as the caufe of the difeafe, though it is rather to be viewed as the effect; and though we could remove the cruft by a wifh, we could not cure the patient, nor does the danger depend upon the incruftation. In children dying of the croup, the paffage for the air is not intercepted by the membrane. Thefe membranes may

ſeparate from the trachea, and be a cauſe of much uneaſineſs; and it may happen that in collecting they may ſtick in the larynx and ſuffocate the patient; but they are no more the cauſe of the diſeaſe than a furred tongue in a fever is to be conſidered as the cauſe of the fever.

Symptoms.

The ſymptoms of croup with which this appearance is attended, are difficult reſpiration, ſtridulous wheezing, cough, hoarſe voice, general fever, with the occaſional expectoration of pus, and a whitiſh membrane.

DCCXIX.

Tracheal Polypus.

A layer of coagulable lymph is found often to line the internal ſurface of the trachea and its branches, without any other morbid appearance affecting the membrane. This affection ſhews no marks of inflammation, and is of long continuance. At other times, a more ſolid ſubſtance fills the ſame ſituation. In both caſes the veſſels ſeem to diſplay a peculiar action in ſeparating the coagulable lymph, which is coughed up in a tubular form, and has been termed a polypus.

Symptoms.

The marks of this affection are difficult breathing, a dry cough, an increaſed pulſe, without any attending ſigns of inflammation, and, at times, pieces of the polypus coughed up.

DCCXX.

Tracheal Schirrus.

By this affection the paſſage of the trachea is narrowed, its ſubſtance thickened, and its inner membrane formed into hard tubercles. Along with this, ſwelling of the neighbouring lymphatic glands is conſpicuous.

Symptoms.

The marks of this ſtate cannot be certainly determined, for the ſame ſymptoms will attend as mark ſome of the preceding affections.

DCCXXI.

Oſſification of the Tracheal Rings.

This ſtate will be little attended to when ſlight; but, when ſo conſiderable as to affect the functions of the part by leſſening the flexibility of the membrane, its cavity will not contract in the neceſſary degree. The air and mucus form the pulmonary cavity.

Symptoms.

The accumulation of mucus, or rather its difficult diſcharge, will be the only leading mark of this morbid affection.

DCCXXII.

Ulcer of the Trachea.

The trachea, like other paſſages, is liable to ulceration, though this moſt frequently ſpreads from the æſophagus to it, and the diſeaſe falls to be conſidered under the æſophagus.

DCCXXIII.

Aphthous Æſophagus.

A layer of coagulable lymph is ſound to extend from the mouth over the æſophagus, and even to occupy the alimentary canal. This appearance forms what is named aphthæ. An increaſed vaſcularity attends it, though leſs conſpicuous in the æſophagus than in the other parts, and it generally diſappears after death.

Symptoms.

The ſymptoms of this affection are known by the appearance of the mouth.

DCCXXIV.

Spaſm of the Æſophagus.

Irregular contraction of its muſcular fibres at a particular part, is common in hyſterical patients, which continues after death, and gives a hardneſs of feel. This may accordingly, often repeated, lay the foundation of permanent diſeaſe, and excite inflammation ſo as to terminate in ſome of its ſecondary conſequences.

Symptoms.

This ſtate is marked by occaſional difficulty of ſwallowing, ſudden in its attack, and ſudden in its remiſſion; neither is there any change of the general health.

DCCXXV.

Partial Stricture of the Æſophagus.

A narrowneſs of this canal at a particular place,

is ſometimes formed by a puckering of the inner membrane to ſuch a degree as hardly to allow a pea to paſs; and no other attending morbid change ſeems connected with it, to account for the altered organization. This affection is ſlow in its progreſs for a period of years.

Symptoms.

The conſtant difficulty of ſwallowing, and the long period of its duration, are the only leading ſymptoms of this complaint.

DCCXXVI.

Ulcerated Stricture of the Æſophagus.

Ulceration of the æſophagus is the moſt common morbid change conſpicuous in this part, and it is generally preceded by its ſchirrous ſtate, conſequently, by a thickening of the ſubſtance to a greater or leſs extent. This thickening is either of a hard uniform ſubſtance, or of a membranous griſtly nature. By this circumſtance a contraction of the paſſage is induced, and often an almoſt total obliteration takes place. The moſt frequent points of ulceration are the upper and lower parts of the æſophagus, from the arrangement of their muſcular fibres rendering them more liable to be affected by irritation. Ulcerations here, however, are generally induced by no apparent cauſe; and, when affecting the upper part, they extend to the thyroid gland, which aſſumes the ſchirrous, and afterwards the ulcerated ſtate.

Symptoms.

This difeafe is marked by its gradual progrefs. The difficulty of fwallowing, at firft flight, gradually increafes. In the advancement of the difeafe the food becomes rejected, and there is feen along with it the occafional appearance of pus. The pulfe is increafed, emaciation takes place to an extreme degree; the neighbouring parts, from irritation, fhew an increafed difcharge; hence cough and hawking arifes. Little nourifhment is received, and yet the fenfe of hunger is not great.

DCCXXVII.

Cartilaginous Æfophagus.

The converfion of the æfophagus into cartilage is only very partial, and may be confidered as a greater degree of fchirrous or griftly hardnefs in a particular point.

Symptoms.

The fame fymptoms diftinguifh it as fchirrus before ulceration.

DCCXXVIII.

Fungous Pharynx.

Fungofity of the pharynx, to a certain extent, though rare, has been met with. On diffection it difplays a fibrous ftructure, with its furface more or lefs ulcerated. A fcrofulous tumor has been obferved in the fame fituation.

Symptoms.

The ſymptoms are much the ſame as thoſe of the æſophagus.

DCCXXIX.

Dilated Pharynx.

A dilatation of the lower end of the pharynx, forming a pouch, occaſionally appears where a nucleus firſt gives a prediſpoſition to it, by forming a ſmall bed. Thus it has ariſen from the ſtoppage of a cherry-ſtone at this part, which, though removed in a few days, left a ſmall cavity. By this occaſion was given for the conſtant reſting of the food in future there; and the ſubſequent change was of courſe a gradual conſequence.

Symptoms.

The only marks of this ſtate are the difficulty of food paſſing into the æſophagus, and at laſt becoming ſo difficult as to deſtroy the patient.

DCCXXX.

Vena Azygos enlarged.

This vein has been occaſionally known to be varicoſe, and alſo a rupture of it to take place.

Symptoms.

No external marks, however, can give evidence of this ſtate.

DCCXXXI.

Enlarged Thoracic Duct.

The chief morbid change on this part is its varicoſe ſtate, and without any other appearance

of difeafe. This can be known by no external fymptoms.

DCCXXXII.

Obftructed Thoracic Duct.

An obftruction of the thoracic duct has been feen by the depofition of an earthy matter in it. It is only partial, and by its branches the nourifhment is ftill conveyed to the fyftem. Rupture of it, though a rare occurrence, has been alfo known.

DCCXXXIII.

Afcitic Abdomen.

Dropfy of the abdominal cavity is more frequent than elfewhere, and appears at every age, and in both fexes. Middle and advanced life are its moft common times of attack.

By the diftention of the abdominal cavity, the fuperficial veins are feen turgid with blood, the fkin of the navel is protruded and yields to preffure, though this is not a conftant fymptom. On opening the cavity of the abdomen, the aqueous fluid difcovered is of a brownifh colour, though varying according to circumftances. An affection of the liver gives it a yellowifh or greenifh hue. At times, alfo, it is of a chocolate or coffee colour. Where no difeafed vifcera attend, the morbid accumulation refembles the ferum both in colour and properties. The accumulation of the abdomen often produces contraction of the inteftinal canal. The liver, or fome of the other vifcera in a

ſchirrous ſtate, is commonly connected with acites, though not always. Accumulation of water, alſo, in the other cavities, is frequently conſpicuous, particularly in the cheſt and lower extremities.

Symptoms.

The ſymptoms of aſcites are, a diſtended fluctuation on applying the hand to the belly and ſtriking it with the other, paucity of urine and high coloured, thirſt, and ſenſe of heat, with ſome frequency of pulſe. In the advanced ſtage reſpiration is impeded.

DCCXXXIV.

Inflamed Peritonæum.

The peritonæum is leſs ſubject to inflammation than the pleura, and it occurs at times in both ſexes, though women after parturition are peculiarly prediſpoſed to it. The inflamed peritonæum appears thick, pulpy, and leſs tranſparent, with an increaſed vaſcularity. The inflammation never extends to the muſcles, but it affects the inteſtinal canal, and penetrates through the coats of the bowels.

The extent of peritonæal inflammation varies, being at one time ſlight and partial, at another great, and general over its ſurface. When chiefly affecting the inteſtinal diviſion, broad bands of inflammation are formed, which obſerve the courſe of the inteſtines, and are formed by the contact of the different inteſtinal portions; and the inteſtines,

when examined, are no way thickened in their texture by the progrefs of the inflammation; but, where the inflammation is evident, the inteftines acquire a thicknefs and maffy feel, in confequence of increafed action of veffels and extravafation. The peritonæal appendages, or the mefentery and mefocolon, are much thickened, as well as the omentum; and this may be afcribed to the extravafation of coagulable lymph that takes place to this cellular fubftance. Befides thefe changes, different portions of the vifcera are often glued together by a yellowifh pulpy matter, varying in its degree of thicknefs in different cafes by the coagulable lymph of the blood; and with this there is effufed a brownifh fluid in the cavity of the abdomen, of a ferous nature, mixed with threads of coagulable lymph, and occafionally pus, by which it is rendered turbid. Thefe extravafations often extend in proportion to the apparent degree of inflammation. Pus and air are alfo part of the collection met with here, the latter being moft common in flight cafes.

Symptoms.

The marks of peritoneal inflammation, are pain of the abdomen, with fome fwelling, and much forenefs to the touch. The pulfe is increafed and hard, with other general marks of fever, and moft commonly coftivenefs. In flight cafes, the fymptoms are often hardly perceptible, and hence the

difeafe is found highly infidious, and its true nature only difcovered by diffection.

DCCXXXV.

Abdominal Adhefions.

The effect of peritonæal inflammation, where not fatal, and much coagulable lymph is thrown out, is to form a fine tranfparent membrane, which is the medium of adhefion. This procefs foon takes place, and the membrane poffeffes the fame appearance as cellular membrane in other parts, and poffeffes a fufficient fhare of vafcularity. Hence it can be injected, and fhows alfo a rednefs when inflamed. This membrane alfo elongates with the action of the vifcera; and though joining them together more or lefs, it is attended on that account with lefs inconvenience than might be fuppofed.

Symptoms.

No peculiar fymptoms attend the prefence of adhefion.

DCCXXXVI.

Scrofulous Accumulation on the Peritonæum.

A white, foft, granulated matter, appears at times behind the peritonæum, and feems very univerfally extended, formed in one large thick mafs, or in fmall ones. The omentum feems entirely changed into this fubftance. The morbid change feems to refemble that of the abforbent glands in other fituations.

Symptoms.

This appearance is marked by no peculiar ſymptoms.

DCCXXXVII.

Cancer of the Peritonæum.

Small cancerous tumors are found at times adhering to the peritonæum, hard and white in their ſtructure, and occupying that part in the region of the ſtomach. This cannot be traced by any certain marks. Scrofulous tumors have been alſo obſerved here.

DCCXXXVIII.

Abdominal Hydatids.

Abdominal hydatids are found occupying the whole of the cavity. They are connected with ſome of the viſcera, to which they owe their formation; and they particularly proceed from the ſtate of the liver and ſpleen.

Symptoms.

This diſeaſe is to be diſtinguiſhed from aſcites by an indiſtinct fluctuation, on examining as in aſcites; or by none at all, by the commencement of ſwelling in a fixed point, from which it becomes diffuſed. From ovarial dropſy it is diſtinguiſhed by the latter commencing in the ſide, and gradually extending from that over the abdomen, while, in hydatids, the ſwelling is from the upper part of the belly, or region of the liver, ſpreading downwards. This diſeaſe, however, may

begin at any part of the belly, which renders all its diſtinctions doubtful.

DCCXXXIX.

Abdominal Accumulation of Air.

Air is occaſionally collected in the abdomen, without any in the inteſtines. The collection, however, is moſt common in the inteſtines, by which they become diſtended, and their coats thinned; and on examining, it is impoſſible to ſay whether this accumulation takes place in the abdomen or the bowels.

DCCXL.

Morbid Changes of the Stomach.

Inflammation.

General inflammation of the ſtomach is always the effect of poiſon, and therefore not ſo frequent; but partial inflammation is a common occurrence. In the latter caſe, the inflammation is ſeldom violent. The external ſurface ſhews, at this part, an increaſed vaſcularity; and on opening the organ, its ſubſtance is here thickened. The inner membrane acquires conſiderable redneſs, with ſome degree of bloody extravaſation. Common inflammation ſeldom terminates in pus or gangrene. From arſenical poiſon, the moſt violent inflammation of this organ takes place. Much redneſs, and thickening of its ſubſtance, is produced along with bloody extravaſation. Part of the inner membrane is alſo occaſionally deſtroyed, and a thin

layer of coagulable lymph at times thrown out on the furface of the organ. When the fubftance has paffed farther than the ftomach, ulceration of the inteftines has occurred. It has been particularly obferved in the rectum.

Symptoms.

Inflammation of the ftomach is marked by pain in the epigaftric region, increafed on fwallowing, by vomiting, and hiccup, with a frequent fmall hard pulfe, by much heat and thirft, and by an uncommon fenfe of debility. In cafes of arfenic, thefe fymptoms rife to a ftill more violent degree.

DCCXLI.

Hydrophobic Affection of the Stomach.

Diffections of hydrophobic patients fhew the ftomach inflamed at the cardia and great end, and this inflammation feems to defcend from the pharynx and æfophagus. The inflammation is generally of the erifipelatous kind.

Symptoms.

Hydrophobia is peculiarly marked by the morbid averfion at fluids, by the difficulty of fwallowing, and by the ftrong derangement of the mind attending this ftate.

DCCXLII.

Ulcers of the Stomach.

Ulcers of the ftomach occafionally appear on diffection, and they either refemble thofe on other parts of the body, or they appear as if a part

had been cut out with a knife. Thefe ulcers at times only corrode part of the coats, at other times they make a hole in the organ. In the vicinity of this ulcer the coats of the ftomach difplay fometimes a thinnefs, at other times they are thickened, and, on other occafions, they preferve the natural ftate.

Symptoms.

The fymptoms of this affection are, pain of the ftomach and rejection of food, while no plan of treatment gives relief. The difeafe is generally flow in its progrefs.

DCCXLIII.

Schirrus and Cancer of the Stomach.

This difeafe is difplayed chiefly in men in advanced life. Although without predifpofition, intemperance cannot be confidered as its caufe, it then has confiderable influence. Schirrus of this organ is moft commonly partial, and the limits between the difeafed and found part of the organ are generally very diftinctly marked. In partial fchirrus, the pylorus is the part moft affected, from the more glandular nature of its ftructure. By this affection the thicknefs and hardnefs of that part of the organ is increafed; and when cut into, the original ftructure, though ftill diftinct, is altered in appearance by the peritonæal covering acquiring a griftly hardnefs, and the thickened mufcular part being interfected with ftrong mem-

branous ſepta; while the inner coat, beſides being thick and hard, is towards the gaſtric cavity ſomewhat tuberculated. The ulceration of this changed and thickened texture on the ſurface conſtitutes cancer, and fungus frequently proceeds from proceſſes of the inner membrane. The organ is, indeed, often entirely changed into a maſs of a whitiſh or brown colour, or converted into a ſubſtance ſomewhat cartilaginous. In this morbid ſtate the neighbouring abſorbent glands are enlarged.

Symptoms.

Cancer of the ſtomach is attended with pain of the organ, with the rejection of what is taken, and frequently with the vomiting of a coffee-coloured fluid. Emaciation, and ſallow countenance, are attending ſymptoms, with frequency of pulſe, and the formation of hectic. No peculiar ſymptoms mark the diſeaſe where unaccompanied with ulceration.

DCCXLIV.

Small Tumor of the Stomach.

An occaſional appearance of ſchirroſity, different from the former affection, is met with in a ſmall tumor the ſize of a walnut, while the reſt of the organ is entirely in a healthy ſtate. What effects this tumor may have under the influence of irritation in diſordering the functions of the organ, have not been aſcertained. Mechanical means may produce a preternatural cavity in the ſtomach,

or a pouch. Where that occurs, the coats of it are thinner.

DCCXLV.

Stricture of the Pylorus.

Stricture of the pylorus oftener occurs than at the cardia, as the fibres poſſeſs ſtronger powers of contraction; and it has been found ſo great as hardly to admit a gooſe quill to paſs from the ſtomach into the duodenum.

Symptoms.

The chief ſymptoms of this ſtate will be the rejection of every thing taken, and fixed pain in that part; while the body, from being deprived of its nouriſhment, ſoon declines.

DCCXLVI.

Altered Capacity of the Stomach.

The ſtomach is ſometimes ſo contracted as not to exceed the ſize of a ſmall inteſtine, and on other occaſions its dimenſions are equally enlarged. Theſe appearances are not the effect of diſeaſe, but depend on an irregular contraction or relaxation of the muſcular fibres at the period of diſſolution. The ſtate of dilatation is moſt frequent.

DCCXLVII.

Diſtenſion of the Stomach.

Though generally flaccid and empty at death, this organ is alſo found occaſionally diſtended with air, and this air is commonly extricated from the contents of the ſtomach, or from its circulation.

Symptoms.

The ſymptoms of this ſtate are external ſwelling of the epigaſtric region, with a ſenſe of diſtention and wind paſſing up by the œſophagus; occaſional pains alſo occur in the ſtomach, the effect of ſpaſm.

DCCXLVIII.

Solution of the Stomach.

On examining the great end of the ſtomach after death, from the action of the gaſtric fluid, there its coats appear thin, tranſparent, and pulpy; and at times the ſtomach has been completely diſſolved by the ſame cauſe, and its contents effuſed into the abdomen. In the ſame way it is known to act on the neighbouring viſcera, which ſuffer a partial ſolution. This effect only happens in thoſe who have died in health, and whoſe ſtomachs have not been impaired by diſeaſe.

Fatty tumours, biliary calculi, and puſtular appearances, are alſo met with, though very rarely, on examining the ſtomach after death.

DCCXLIX.

Morbid Changes of the Intestines.

Inflammation.

A variety of cauſes induce inflammation here; and the appearance which ſuch inflammation produces is, firſt, an increaſed vaſcularity of its ſurface, which extends alſo through all its coats, being frequently attended with bloody extravaſation. While the inteſtine is thus altered, the

peritonæum is often little affected; but, at other times, it is alſo inflamed, and covered with coagulable lymph, which is frequently thrown out upon the ſurface of the villous membrane. In more violent caſes, the inteſtine receives an additional thickneſs and weight, with its colour much darkened from extravaſation, ſo as almoſt to reſemble gangrene.

Inflammation of the inteſtine commonly paſſes into a ſecondary ſtage, or ſuppuration, and ulceration, particularly where the inflammation attacks the internal membrane; and this ſecondary ſtate never commences on the external membrane. The great inteſtines are more ſubject to this termination of it than the ſmall ones.

Ulceration of the inteſtines is attended with conſiderable variety in its appearance, diſplaying at one time a thickened ragged edge, at other times being little changed from the internal appearance, and ſometimes ſmooth, as if a ſection had been made with a knife. In the progreſs, the inner membrane hangs frequently in ſhreds, or is ſtripped entirely from the inteſtine, leaving the muſcular ſurface bare. Ulceration of the inteſtine either terminates by eroſion, ſo that the inteſtinal contents paſs into the abdominal cavity, or adheſion is formed by the ulcerative inflammation to ſome neighbouring part, and thus a new communication or paſſage is eſtabliſhed. Such commu-

nication is generally the means of ſupporting life longer than otherwiſe.

From its peculiar ſecretion and ſtructure, the inner inteſtinal membrane is more ſubject to ulceration than any other in the body. But, inſtead of ulceration, a more common termination of inteſtinal inflammation is by gangrene, the part aſſuming a black livid colour, and loſing all tenacity, which is the chief mark, more than the colour, of this ſtate. The conſequence of gangrene here, is the formation and accumulation of a conſiderable quantity of air in the inteſtinal cavity. The gangrenous part, when completely mortified, has been known to ſeparate from the reſt, and, though fatal in the event, to be expelled by the anus.

Symptoms.

Inflammation of the inteſtines is known by acute abdominal pain, vomiting and coſtiveneſs, with heat and thirſt. The pulſe here is generally frequent, ſmall, and hard.

DCCL.

Intuſ-ſuſception of the Inteſtines.

This affection conſiſts in the paſſage of one portion of the gut within another for ſome length, dragging after it its part of the meſentery; and the received portion is commonly in a contracted ſtate, being, for the moſt part, an upper portion falling into an under one; though this is not always the caſe. The moſt frequent ſort of in-

tuſ-ſuſception is the ſmall inteſtine, particularly where the ilium terminates in the colon. Intuſ-ſuſception is ſometimes diſentangled by the natural periſtaltic action, but more frequently from the degree of inflammation the parts thicken, and are glued by adheſions producing fatal obſtruction of the paſſage of the inteſtine.

Symptoms.

Intuſ-ſuſception, in its advanced ſtage, is marked by the ſame ſymptoms as inteſtinal inflammation; but, from the ſtate of the parts, and their forming adheſions in conſequence of inflammation, it is more fatal.

DCCLI.

Concretions.

Several concretions are met with in the inteſtines, and they are by no means a rare occurrence. Moſt of them have nuclei, and we may ſuppoſe them in others, where they ſeem to be wanting; for we can imagine a clot of blood to ſerve as a nucleus which may afterwards ſhrink, ſo that we can ſcarcely perceive it on cutting the ball. In order to give ſome kind of idea of one way in which ſuch balls may be formed, we perceive in balls taken from the ſtomach of a cow, that they are plainly compoſed of hairs that are always of the ſame colour with thoſe on the ſurface, and theſe are formed by the animal licking itſelf; the hairs are determined to the throat part

by the rugæ of the mouth, &c. and ſo come to be collected in the ſtomach. In like manner we may imagine concretions formed within ourſelves, but we are not to imagine that the undigeſted and fibrous part of the aliment alone forms the concretions, there may be ſuch an attraction of the nucleus to parts of the aliment as takes place in the veſica urinaria: ſo within our alimentary canal are found the incruſted ſeeds of gooſeberries, and ſeveral concretions which reſemble gall ſtones, or ſuch concretions as are found in the ſalivary ducts. If we ſuppoſe theſe to form in the ſtomach, yet they ſcarcely ſtop till they come very low, and are moſt frequently found in the great inteſtines, particularly in the beginning of the colon, in the caput coli more eſpecially, or in the caput cæcum coli, where they are very much out of the circulation of the food, and the caput coli is ſometimes found at the ſame time of very conſiderable ſize.

Symptoms.

We could judge of this diſeaſe, if a perſon, without ſeeming to have any great weakneſs in the ſtomach, or being ſubject to nervous complaints, has a frequent pain. If this is ſituated in one particular part of the inteſtines, and remains there for a conſiderable time, if it comes in an uncertain manner, without the patient being able to find a cauſe, that no error is committed in diet; at one time, perhaps, the patient has a looſe belly,

at another time there is a total ſtoppage, and that made mechanically, by the ball blocking up the paſſage; ſoon after which there is perhaps a great diſcharge of the fœces, and that not without a great deal of pain; and we diſtinguiſh particularly a ball of this kind, by the patient feeling a pain upon preſſing upon the part, and we can diſcover a remarkable hardneſs. If we find that this has very much changed its place, or is ſituated where no ſolid bowel is to be found, were it under the left ribs, we might apprehend that it was the point of the ſpleen in a ſchirrous ſtate; whereas, if we find it at the ſide of the umbilicus, we would conclude that it is owing to ſuch a concretion.

DCCLII.

When a ball of this kind has reſted long in one place, by inflammation and irritation the coats of the gut are thickened; and the ſame cauſe acting, the gut is conſtricted, though the diameter of the ball is not at firſt greater than that of the gut: in conſequence of this conſtriction in it, it comes to be impoſſible for the ball to paſs, and there comes to be an adhæſion to the containing parts of the belly.

DCCLIII.

Worms.

Next, we meet with different kinds of worms, viz. the tape worm and the ground worm. It has

been imagined that the tape worm was a chain of animals totally diſtinct from each other. Of ground worms, connected by tenacula; but, by injecting the tape worm, there is a real communication between its joints, ſo that the whole joints make but one animal, but every joint is at the ſame time capable of living, as being provided with a mouth, but they live beſt when connected; for, ſuppoſe that ſome joints do not receive proper aliment, they can receive the nouriſhment from the ſuperior joints.

DCCLIV.

It has been imagined that it is in a continual ſtate of growing, by freſh additions to the number of joints; but we have no proof of this; and the only queſtion is, Whether the pieces when joined, have at the end one piece different from the reſt, by which the animal lays hold of the inteſtines? and Dr. Tyſſon has in a great meaſure proved this.

DCCLV.

Next, the *lumbricus*, which is eſſentially and totally different from the earth worm. This is more eaſily expelled, but it is more dangerous than the former, as preying not only upon the contents, but on the coats of the inteſtines, eroding great portions of the villous coat. Here, indeed, it generally ſtops, the other coats reſiſting it from their greater hardneſs, and containing leſs of its nouriſhment; but, in ſome caſes, theſe too

are found eroded and perforated, and we are not to conceive that this happens after death when the animal is uneaſy, and wants to eſcape, for we have inſtances where this worm has made its way through abſceſſes.

DCCLVI.

Next, the *aſcaris*, which appears only a young lumbricus, and not a diſtinct ſpecies. It has been repreſented as having two heads, as it burſts from the corrugation occaſioned by its being kept in ſpirits, but in ſhape it approaches near to the lumbricus, and we have found them exiſting at the ſame time.

DCCLVII.

Ruptures, or Inteſtinal Diſplacement.

A portion of the abdominal viſcera is frequently carried out of the cavity from ſome ſudden violent exertion, and lodged in a ſac of elongated peritonæum, forming what is termed a rupture. This diſeaſe is ſo frequent, that one out of every eleven is calculated to labour under it; and though every part of the abdominal contents may be occaſionally diſplaced in this way, the omentum and inteſtines are moſt frequently ſo. The moſt common places of this diſplacement, are the rings of the muſcles of the abdomen where the ſpermatic chord paſſes, and the round ligament in the female, or behind that ring at the lower edge of the external oblique, where the veſſels paſs down to the thigh.

The bowels that will moſt readily fall out, are;

1. The turns of the inteſtinum ilium, the meſentery lengthening as we go downwards, ſo that, beſides the end of the ilium being nearer to the ring, the meſentery is longer.

2. The omentum, which is the part moſt frequently found in the hernial ſac, and it may carry along with it the large and looſe arch of the colon.

3. The great ſac of the colon may fall down from the weight of the fœces puſhing it gradually lower down, and bringing it nearer to the rings of the muſcles as life advances, ſo that elderly people are particularly ſubject to this complaint.

When the omentum has remained long in the ſac, it forms a pretty compact maſs, for the moſt part, though not always adhering to the inner ſurface of the ſac; and, though occaſionally without inflammation, at other times it is ſo violent as to produce gangrene.

Along with the omentum, a portion of the inteſtine is often lodged in the ſac, and often the inteſtine is lodged itſelf, without any omentum. The ſize of the portion varies in different caſes; and where the functions come to be interrupted by the preſſure of the ring, or opening of the ſac, ſo as to induce inflammation, the diſeaſe often ends fatally.

The appearances of inflammation here are the ſame as formerly deſcribed; and its aſſuming the

ſtate of gangrene is marked by its deep and livid colour, by its want of tenacity, and its diſtenſion with air. When the inflammation terminates favourably, ſtill adheſions form, which attach the gut for ever after to the inner ſurface of the ſac.

The ſac, or containing part, when firſt deſcending, is a thin opake membrane, of a firm texture, and white colour, being merely the peritonæum ſomewhat thickened by preſſure. In caſes, however, of long ſtanding, its ſtructure becomes changed; and, in conſequence of thickening, it is diviſible into ſeveral layers. Internally, its ſurface is ſmooth, and is extended from the inner coat of the peritonæum. Externally, the ſurface is rough and irregular, and, at the ring, it poſſeſſes a narrow neck, correſponding to the ſituation of the parts.

Symptoms.

Rupture is marked by a pale ſwelling at the ſeat of the diſplacement, with a ſlight occaſional pain in it, diffuſed over the belly, and the ſwelling protruding with every exertion; by its diſappearance in the horizontal poſture, and its admitting being puſhed up, though not always when of long ſtanding.

DCCLVIII.

In the ſtage of ſtrangulation, to theſe general ſymptoms are to be added thoſe of inflammation, or moſt diſtreſſing ſickneſs, vomiting, obſtinate

coftivenefs, with heat, thirft, and frequent fmall hard pulfe, ending in hiccup, and the appearance of yellow fœtid matter from the mouth. In fome cafes, however, the pulfe is little increafed.

DCCLIX.

Congenital Rupture

Differs from the other in the fac being the fame with that of the tefticles, arifing from the opening at the ring not clofing at birth, after the defcent of the tefticles, and a portion of the inteftine, or omentum, falling into the elongated portion of the peritonæum.

Symptoms.

The chief mark of this fpecies, is its appearance coëval with birth.

DCCLX.

Schirrus and Cancer of the Inteftines.

This affection is moft frequent in the large inteftines in advanced life, and its moft common feat is the figmoid plexus of the colon or rectum; and this proceeds from the greater glandular ftructure, and the narrownefs of the gut at the former part. The difeafe is commonly here very circumfcribed, though it has been known to extend fome inches; and it differs in nothing from the appearance affumed by the ftomach under the fame difeafe. The coats acquire a thicknefs and hardnefs; the internal one, efpecially, is formed into hard irregular folds, and they are in general divided by

membranous fepta. The ulceration of the inner furface, in this ftate, produces cancer; and, in the advanced ftage of the malady, the ftructure of the gut is changed into a griftly hardnefs. The confequence of fchirrus is a contraction of the paffage of the gut, which becomes at times almoft obliterated; and above this contraction, it is enlarged in the fame proportion from the accumulation that neceffarily takes place. Another confequence of this affection, is the formation of adhefions between it and the neighbouring vifcera, occafioning ulceration to fpread.

Symptoms.

The progrefs of this difeafe is at firft flow, and there is little pain in the part, the patient only obferving a coftivenefs, and fome difficulty in the paffage of the ftools. In time, pain comes to be felt in the part on ftool, after which it becomes relieved. In the ftools, pus and blood is occafionally mixed, efpecially towards the termination of the malady. The fallow countenance is here a leading mark of the difeafe, with much general debility and quicknefs of pulfe. The conftitution gradually failing, the patient is at laft cut off.

DCCLXI.

Dyfenteric Inteftine.

The gut is here confiderably thickened with irregular tubercles of a white or yellowifh colour, and frequently there appears an abrafion of the

inner membrane. But the moſt frequent appearance in fatal dyſentery is increaſed vaſcularity and ulceration of the inner membrane.

Symptoms.

The ſymptoms of dyſentery are griping, and often moſt acute pains of the belly, frequent evacuations of various matters, as mucus, pus, blood, membranous fibres, white lumps, and hardened fœces. Teneſmus is a conſtant ſymptom after ſtool, and there is frequently more or leſs general fever.

DCCLXII.

Thickened Rugated Membrane.

This appearance conſiſting in the great inteſtine formed into broad thick folds, containing an accumulation of blood, is a rare occurrence. On examination, it is found an accumulation of cellular matter behind the gut. Above the anus, alſo, little proceſſes ſometimes grow from the inner membrane, forming a circle acroſs the gut.

Symptoms.

Theſe changes are diſtinguiſhed by no peculiar external marks.

DCCLXIII.

Piles.

Piles and ulcerations of the anus are common diſeaſes. The former are ſoft tumors of various ſhapes, ſituated round the verge of the anus, covered with a fine ſkin, partly derived from the

external covering of the anus, and partly from the inner membrane of the gut. Though entire, through theſe tumors much blood is often diſcharged, and they conſiſt of the veins round the anus much enlarged.

Such tumors alſo form within the rectum, termed internal piles, occaſioned by an enlargement of the veins, frequent in advanced life, which is the common period of their attack. They are the effect of long continued obſtruction to the return of the blood from the rectum. On this account they are more frequent in women than in men, in conſequence of ſuch obſtruction laid by pregnancy, and from the greater tendency in women to coſtiveneſs from their mode of life.

Symptoms.

Piles are eaſily known by external ſwellings at the anus, or within the rectum, by pain in their ſeat on the paſſage of the fœces, by an occaſional flow of blood, and ſenſe of irritation in the part; and theſe local ſymptoms are often preceded by conſtitutional ſymptoms of turgeſcence, as giddineſs, dyſpnæa, colic, and lumbar pains.

DCCLXIV.

Fiſtulæ.

Fiſtulæ are ſeated at the lower end of the rectum. They are narrow canals, with a ſmooth internal ſurface, poſſeſſing a purulent ſecretion, and terminating externally by a callous edge. The

canal is either ſingle, or divided into branches. It has an external opening by the ſide of the anus, frequently a ſmall one into the gut, and at times one at both extremities. The firſt, however, is moſt common.

Symptoms.

No external ſymptoms mark this diſeaſe.

DCCLXV.

Malconformation of the Rectum.

Some inſtances of the malconformation of the rectum occur by its terminating in a third ſac, without any external opening; and on perforation of the part, the end of the gut is found at ſome diſtance. The ſtrong tendency of the parts to contract afterwards, is always againſt the ſucceſs of an operation.

In the ſame way the rectum is known, at times, to terminate in the bladder, which admits no relief; and occaſionally, though rare, in the vagina.

DCCLXVI.

Worms.

Worms occupy the inteſtines of man, as well as thoſe of other animals; and they are confined, as already noticed, to three ſpecies, the lumbricus teres, the tenia, and the aſcaris.

Symptoms.

The ſymptoms attending the preſence of worms here, are ſwelling of the belly, offenſive breath, emaciation of the extremities, and deranged ap-

petite, with picking of the nofe, and grinding of the teeth in fleep. Thus the appetite is at times very great, at other times very fmall, and the ftools are generally flimy.

The fymptoms of the tenia are, a gnawing in the region of the ftomach, leffened or removed by eating, irregular appetite, as in the former, itching of the nofe and giddinefs, naufea, and cholic; at times, cough and convulfions.

The marks of afcarides are, uneafy feeling of the rectum, and itching of the anus; with heat, tenefmus, and mucous ftools mixed with blood or afcarides.

DCCLXVII.

Accumulation of Air.

An accumulation of air in the inteftines is attended with flight peritonæal inflammation; and the inteftinal veffels are frequently filled with it. This either arifes from the contents of thefe parts being extricated by the procefs of digeftion, or it is fecreted by the veffels, and poured out here, which is more probable, as being found to confift moftly of carbonic acid gas.

Symptoms.

The marks of this accumulation are, fome abdominal fwelling, often fhifting its place, and attended with a kind of gurgling noife, coftivenefs, and occafional cholic. When largely accumulated, it forms tympany, known by the tenfe elaftic feeling

of the ſwelling, by ſome dyſpnæa, by ſevere cholic and coſtiveneſs, and by occaſional diſcharge of flatus both upwards and downwards.

DCCLXVIII.

Oſſeous Accumulation.

An oſſeous matter has been at times ſeen thrown out upon the ſurface of the inner membrane of the gut; and even an adheſion of the inteſtine, in two points, has been ſeen converted into bone. Thus an oſſeous matter is capable of being depoſited by ſecretion in any part of the body. Calculous matter has been alſo mentioned as occaſionally occurring in the inteſtines.

DCCLXIX.

Inflamed Meſentery.

This is generally conjoined with that of the peritonæum; and under inflammation the meſentery becomes thick and maſſy, and its large veſſels are much obſcured from the extravaſation of coagulable lymph, while the vaſcularity of the adjacent peritonæum is increaſed.

Pus is occaſionally found on the meſenteric ſurface, and abſceſſes between its layers; but theſe circumſtances are rather uncommon. It ſeldom extends beyond ſimple inflammation, except where gangrene of the inteſtines occurs, and it partakes in the ſame ſtate.

Symptoms.

The ſymptoms of this affection are the ſame

with thoſe of the peritonæum, and cannot be diſjoined.

DCCLXX.

Morbid State of the Meſenteric Glands.

The meſenteric glands are apt to aſſume three different ſpecies of morbid diſpoſition, viz. a ſcrofulous, cancerous, and earthy one.

1. The firſt is moſt frequent in children, where they become enlarged in ſize, and ſomewhat ſofter than natural to the touch, diſplaying, on diſſection, either the natural ſtructure, or a change in part into a white, ſoft, curdy matter, not uncommonly mixed with pus.

2. The ſecond differs nothing in appearance from ſchirrus elſewhere, and is commonly the conſequence of a cancerous affection of the inteſtines.

3. The third is an accumulation of earthy or oſſeous matter in the glands, which is, indeed, a rare occurrence, compared with its appearance in thoſe of the lungs.

Symptoms.

The marks of enlarged meſenteric glands are, a ſwelled belly, and emaciation of the extremities, with the conſtitutional appearance of ſcrofula, and no traces of worms.

Hydatids and fatty tumors attached to the meſentery are rare appearances, though they have been enumerated.

DCCLXXI.

Morbid Changes of the Liver.

External Membrane inflamed.

This affection is often conjoined with that of the peritonæum. It occurs, however, without this connection; and though it ſpreads, at times, over the whole of the organ, yet it more commonly affects only its anterior convex part, ſometimes the ſide next the ſtomach and duodenum. The appearances here are the ſame as in the peritonæum, an increaſed vaſcularity occurs, and alſo a thicknefs of its ſubſtance, with a layer of coagulable lymph thrown out, differing in thicknefs in different caſes, and glueing the organ more or leſs to the adjacent parts. A ſerous fluid is alſo ſometimes effuſed.

Symptoms.

The ſymptoms are much the ſame with thoſe of pleuriſy, acute pain of the lower part of the right ſide, dyſpnœa, cough, and ſymptomatic fever.

DCCLXXII.

Adheſion.

The conſequence of hepatic inflammation is the forming adheſions, which ariſes from the organization of the coagulable lymph thrown out. This organization forms it into a thin tranſparent membrane, which connects the organ with the adjacent parts. This connection is either general over the ſurface, or conſiſts of different ſmall proceſſes.

The mode of adhesion is occasionally by a long membrane, at other times by a close attachment. The anterior part of the liver is the most common seat of those attachments. In cases of adults, those adhesions prevent the diffusion of pus in the abdomen. The posterior part of the liver is, at times, connected to the stomach and duodenum, and adhesion there will have a similar effect as in the former case of abscess.

Symptoms.

No peculiar external symptoms lead to a knowledge of adhesions.

DCCLXXIII.

The coats of the liver suffer, at times, a partial conversion into cartilage, which is smooth, thin, and of a softish texture. This, however, is a rare circumstance, and can be previously ascertained by no symptoms.

DCCLXXIV.

Inflammation of the Liver.

This affection is peculiar almost to a warm climate, while that of its coats occurs in a cold one. This inflammation of the organ is attended with an enlargement of its size, and a deep purple colour of its substance, with a general jaundiced colour of the skin. Its outer membrane is not always affected by this state of inflammation. The progress of this inflammation is to terminate by abscess; and this abscess is often so large as to contain some

pints of matter. Sometimes the whole liver is converted into this containing bag; and the difeafe is generally accompanied by afcites, the fluid of which is of a yellow or green colour, from the tinge of the bile. Gangrene of the liver is a very rare occurrence, if ever taking place.

Symptoms.

Inflammation of the liver is marked by obtufe pain in the right hypochondrium, rifing to the top of the fhoulder, by difficult recumbence on the found fide, by a dry cough, with hiccup and vomiting, by an occafional jaundiced appearance, and in general by fymptomatic fever; though, when flow in its progrefs, both pain and fever are at times unknown; and its prefence is only detected by the formation of an abfcefs.

DCCLXXV.

Tubercles.

A frequent difeafe of the liver is, the formation of tubercles, efpecially in men from middle to advanced age who are addicted to excefs in drink; and thefe tubercles are diffufed generally over the whole organ, of a rounded fhape, and fituated near each other. By this affection, the hepatic furface is every where irregular, and their diffection exhibits a brownifh or yellowifh white matter. Their moft common fize is that of hazel nuts, though known occafionally as fmall as a pin head. With this irregularity, the liver feels hard

to the touch, eſpecially at the lower edge, which is bent a little forwards. Its ſize is, however, generally diminiſhed on the whole; and its veſſels, when it is cut into, ſhew a leſſened diameter. Its colour is frequently yellow, and water is found in the abdominal cavity of the ſame tinge. The gall bladder is generally contracted, white, and empty; and the cheſt is yellow, or ſuffuſed with bile.

Symptoms.

The ſymptoms of ſchirrous liver are, pain or uneaſy feeling in its region, continuing long, and attended at laſt with jaundice and water in the abdomen. This ſtate of the organ, at its lower edge, can at times be felt when the abdominal accumulation is ſmall.

DCCLXXVI.

Beſides this common ſtate of tubercles, other varieties occur, which are of three kinds, the white, the brown, and the ſcrofulous.

1. The firſt of theſe, which are rare, equal in ſize a cheſnut. They are ſeated moſt commonly near its ſurface, two or three together, while the intermediate ſpace of the organ is free from diſeaſe. They conſiſt of firm, opake, white ſubſtance, depreſſed and hollow in the outer parts, forming as it were round the blood veſſels; and, when they occur, the organ is increaſed in ſize with or without abdominal accumulation; and,

in the ſame way, with or without a change of colour.

2. The ſecond ſpecies of tubercles is, the ſoft brown, which is not ſo large as the former, but occupies the ſame ſituation, and conſiſts of a ſmooth, ſoft, browniſh matter.

3. The third ſpecies is the ſcrofulous tubercle, reſembling entirely thoſe of the lungs; but this appearance is very rare, and theſe tubercles are diſperſed regularly through the ſubſtance of the liver, without producing any irregularity of its ſurface. At times, with ſuch tumours, the liver is found more flaccid in its ſubſtance than is natural. In ſuch caſes of flaccidity, the liver has been found alſo very ſoft.

DCCLXXVII.

Morbid Hardneſs.

A general hardened ſtate of the liver occaſionally appears, which, when cut into, diſcovers no other peculiar morbid change. This is conſidered by ſome as the previous ſtage of tubercles.

Symptoms.

Hardneſs of liver is diſtinguiſhed by no peculiar marks, but there will prevail in its progreſs ſome uneaſineſs or weight in its region, joined with a ſallow appearance of the countenance.

DCCLXXVIII.

Hydatids.

No organ is ſo much the ſeat of hydatids as the

liver and kidneys. In the former, they are contained in a firm cyſt, often of conſiderable ſize, having externally a cartilaginous feel, and laminated to appearance within, with various degrees of thickneſs in different caſes. The external ſurface of the cyſt conſiſts of a white matter, the internal of a pulpy ſubſtance, ſimilar to coagulable lymph. The number of hydatids in a cyſt is various. They lie looſe in its cavity, ſwimming in a fluid, or attached to the ſide of the cheſt; and they are compoſed of a white opake pulpy matter, having much contractile power, with a fluid capable of being coagulated; and theſe hydatids contain often within them ſmaller ones, either looſe or attached to their ſides, as in the larger ones. Theſe hydatids of the liver are often unconnected; but, at other times, they ſeem to incloſe each other. The cyſt is moſt commonly within the ſubſtance of the liver, though occaſionally attached to its outer ſurface, and hanging from it into the abdomen.

Symptoms.

No peculiar ſymptoms characteriſe this diſeaſe, and conjecture can only be made of its exiſtence. This conjecture is formed by the gradual formation of a tumor in the region of the liver, by its having little influence on the general health, by its giving to the feel a certain ſenſe of ſoftneſs without fluctuation, or rather an obſcure one, and

by its being traced particularly from the liver as its origin.

DCCLXXIX.

Offeous Depofitions.

Cyfts containing an earthy matter are at times to be met with in the liver. The cyft, in this cafe, is of a cartilaginous confiftence, and its contents are an earthy matter, of a brownifh white colour. This affection can be learnt by no external marks.

DCCLXXX.

Rupture.

Strong preffure upon the liver is found to occafion its rupture; for, inftead of recovering its former ftate after the removal of the preffure, as happens to parts of a more elaftic ftructure, the foftnefs of its texture occafions it to give way. This accident is attended with little pain; but, from the derangement of the circulation, death in a fhort time fucceeds it.

DCCLXXXI.

Worms.

Worms are a rare appearance in the liver, though they have been noticed here, as well as in feveral of the other vifcera.

DCCLXXXII.

From this view of the difeafed ftate of the liver, its organic changes appear numerous, and the following obfervations contain the fum of what claims attention on the fubject.

DCCLXXXIII.

Veſicles we have found in large ſacs, and within each of the larger we find ſmaller. Now, this appearance, though it occurs moſt frequently in the liver, yet it is to be obſerved in various other places, but eſpecially in the abdominal viſcera. Till within theſe few years, theſe very generally were taken for portions of cellular ſubſtance, formed by concretions of the cellular membrane. But Dr. Pallas, an ingenious naturaliſt, conceives that they are animated bodies; which opinion was firſt hinted by Dr. Tyſon in the laſt century; and, upon the whole, his idea is juſt, though in ſeveral reſpects he errs in calling them tenia hydatidea. He ſuppoſes that it is an animal ſomewhat like to that in the inteſtines, and that this produces hydatids; but no ſuch connection can be obſerved; and it may be doubted that the tenia is conſtantly ſending off new joints, or adding to its number, which is a very diſcouraging opinion; for, after we have ſeparated hundreds of joints, it may ſtill form new ones; but by killing joints, we kill a part of the animal, and there is no growth again. And there is a greater probability that they are animated ſubſtances, from our finding cluſters of round bodies within each other adhering to the outer ſkin, which we muſt take to be the parts of the young growing, and that when they have acquired a certain bulk they ſeparate;

and the second having the small structure as the first, contain others, and so on *ad infinitum;* and it only remains to prove that they are living animals, that we distinguish their motions; but they have no manner of communication with the cellular substance, nor have they vessels painting them, so they can only live by fluids poured in from the arterial system; and we find other worms in the liver, the origin of which we can as little explain. There is a species of worm found in sheep that die of the rot, and, perhaps, this is the cause of the rot, as in marshy grounds the disease is more common. We find within the gall ducts a worm of a particular kind, which feeds on bile. From its mouth branches are dispersed, like the branches of an artery, and are all filled with bile; so that the mouth of the animal is its aorta, and the branches are propagated to the most distant parts.

DCCLXXXIV.

When the liver is in a schirrous state, it is sometimes lessened in its bulk. De Haen gives an instance of a schirrous liver not bigger than the fist, but, for the most part, it is bigger; and in the interstices of the vessels we find deposited a sebaceous-like matter, and knots scattered unequally through it; and we can generally distinguish the schirrous by laying the hand on the edge of the the thorax, and particularly about the

middle, as we can generally firſt feel it under the cartilago enſiformis. The ſize is ſometimes very great, deſcending half way to the umbilicus, and even half way between the umbilicus and os pubis, and yet without dropſy.

DCCLXXXV.

Should a ſuppuration happen in the liver, a conſequence of inflammation, we ought to attend to all the poſſible ways in which the pus can be diſcharged. In a ſound perſon the liver is covered in its under part by the peritonæum, upon which the bowels play freely, and it adheres to the containing parts by its ligaments; but the inflammation breeds adheſions in the neighbourhood: by the ſuppuration the liver is enlarged, deſcends under the edge of the thorax, and the abſceſs frequently adheres to the peritonæum lining the muſcles; ſo if an opening is made under the edge of the thorax, we get into the cavity of the abſceſs without opening the cavity of the abdomen; but if the abſceſs is within the edge of the thorax, it may make its way through the diaphragm; and as this is almoſt contiguous to the pleura, it being thickened and inflamed, may come to adhere to the ſide; and the matter eroding, this may make its way outwards, or into the lungs, if they come to adhere. Caſes of this kind have occurred, where bile has been thrown up by coughing, or it may come to adhere to the parts immediately beneath,

to the ſtomach, and to the great arch of the colon; and we have many examples in practice, where abſceſſes of the liver were freely diſcharged by vomiting and ſtool; or, the matter may get into the cavity of the alimentary canal, by the eroſion of the biliary ducts; and where the matter is very deep in the liver, the matter may find its way into the gall bladder, which has been found diſtended with purulent matter: or, ſuppoſing the abſceſs to burſt into the cavity of the abdomen, the matter may fall down into the pelvis, and reſting on the rectum, may inflame and erode it, and ſo get out of the body.

DCCLXXXVI.

Morbid Changes of the Gall Bladder.

Inflammation.

The coats here, when inflamed, are connected with the inflammation of the membrane of the liver, which is ſpread over the gall bladder, and thus communicates its affections more or leſs to it. No peculiar appearances diſtinguiſh this inflammation from the ſame affection of the ſtomach and inteſtines.

Symptoms.

The ſymptoms are the ſame with thoſe which attend the membranous inflammation of the liver.

DCCLXXXVII.

Adheſion.

Diſſections ſhow frequent adheſions of the gall

bladder to the end of the ſtomach, or beginning of the duodenum, being the effect of previous inflammation. This admits no external ſymptoms.

DCCLXXXVIII.

Ulceration.

Ulceration of the gall bladder, though met with, is a very rare occurrence, and begins in the inner membrane, while the other coats do not appear affected. Neither does it appear to be much an effect of gall ſtones. We have no external information to detect this morbid change.

DCCLXXXIX.

Tubercles.

Tuberculous ſtate of the liver is ſometimes, though rare, communicated to the gall bladder, when its coats alſo are conſiderably thickened; and, in the ſame way, a ſolitary inſtance or two has been obſerved of the coats being converted into an oſſeous matter.

DCCXC.

Dilatation of the Ducts.

The three ducts are often found dilated to an amazing ſize, near the extent of an inch in the tranſverſe diameter. This is the effect of the paſſage of gall ſtones, which often deſcend, of a very great ſize, into the duodenum.

DCCXCI.

Obliteration of the Ducts.

This appearance is very rare, but it has oc-

curred, and may be referred, wherever it takes place, to one or other of the following causes:

1. Violent inflammation of the inner surface of the ducts producing adhesion.

2. The same state of the duodenum involving the ductus communis choledochus.

3. Schirrus of the round head of the pancreas acting by pressure on the same duct.

Symptoms.

The chief symptoms of this state will be permanent jaundice, which may equally arise from a tuberculous state of the liver.

DCCXCII.

Passage between the Gall Bladder and the Stomach.

A deviation from the common structure has been met with in a communication, by a short canal between the gall bladder and small extremity of the stomach.

DCCXCIII.

Gall Stones.

Stones in the gall bladder, or ducts, are a frequent appearance on dissection; and the bladder is often largely distended by them, with its coats proportionally thickened. The existence of a single stone is marked by its oval shape, that of a number by their many sides and angles. In their internal appearance, gall stones differ in their colour, in their internal texture, and in their properties. With regard to the first, their colour is

of confiderable variety, as white, black, and all the intermediate gradations between thefe two extremes. In their external appearance they differ, fome being fmooth in their furface, and others a good deal tuberculated. Their internal texture is made up of concentric laminæ, within which there appears a radiated ftructure. But the proportion of thefe to each other varies in different calculi, and alfo the loofenefs and compactnefs of the matter of which each is compofed. Chemical experiments fhew the conftituent principles, and confequently the properties of gall ftones are fomewhat different.

Symptoms.

The prefence of gall ftones is only detected when they attempt to pafs the ducts; and then, if large, they create moft excruciating pain about the pit of the ftomach, with languor, ficknefs, and vomiting, yellow fuffufion of the fkin, but the pulfe is little accelerated.

DCCXCIV.

Bile.

The moft common appearance of the bile is that of a brownifh yellow colour, with a certain vifcidity greater in man than in other animals. It is changed by difeafe at times into a ropy fluid like mucus; and it is even found deprived of colour like the white of an egg. A tuberculated liver, and enlarged mefenteric glands, attend this change. From the tranfuding of the bile through the biliary coats after death, the ftomach and

duodenum appear always on diffection tinged with this fecretion. Accumulation of bile producing diftenfion of the organ, and alfo a defect of it, attended with contraction of that vifcus, are morbid ftates occafionally met with. Hydatids alfo, in this fituation, are ftated as an occurrence, though rare. Even the gall bladder has been found wanting in cafes of malconformation.

DCCXCV.

Morbid Changes of the Spleen.

Inflammation of the Coats.

The coats of the fpleen are affected with inflammation, only from the affection of the peritonæum. In this ftate they exhibit an increafed vafcularity, a more thickened texture, and a depofition of coagulable lymph on their furface.

Symptoms.

The fymptoms of this affection are, pain of the left hypochondrium, more or lefs acute, increafed on preffure, with fymptomatic fever and difficult refpiration.

DCCXCVI.

Adhefions.

Adhefions of the fpleen to the neighbouring vifcera are often met with, formed by a firm white membrane, and thus it is found attached to the diaphragm, great end of the ftomach, and arch of the colon. Thefe adhefions are marked by no external fymptoms.

DCCXCVII.

Inflamed Subſtance.

This affection is ſo rare that it may be barely noticed.

Symptoms.

The marks of this ſtate deſcribed are, a fullneſs and ſenſe of pain in the left hypochondrium, increaſed on preſſure, with general fever. The ſenſe of pain has been alſo mentioned as diffuſed over the abdomen.

DCCXCVIII.

Morbid Softneſs and Hardneſs.

The ſpleen is found in two oppoſite ſtates, either of preternatural ſoftneſs or hardneſs. The former of theſe is to ſuch a degree that, on breaking the capſule, its ſubſtance ſeems to conſiſt of a browniſh red mucus, intermixed with ſpongy fibrous texture. It is peculiar to middle and advanced life, but is diſtinguiſhed by no peculiar ſymptoms. The latter, or its hardened ſtate, is generally attended with an enlargement, ſo as at times to exceed its proper ſize by 5 or 6 times, when it can be eaſily diſtinguiſhed by the external feel; and it ſhews alſo in this ſtate a greater compactneſs of ſtructure. Water in the abdomen often attends this affection.

Symptoms.

The ſymptoms of this diſeaſe are only diſtinguiſhable externally, in its advanced ſtage, by the

ſituation and ſhape of the tumor, its anterior edge being felt irregular under the margin of the ribs on the left ſide. Aſcites alſo is found preſent.

DCCXCIX.

Tubercles.

Scrofulous tubercles occaſionally appear on the ſpleen, ſimilar to thoſe on the lungs; but no peculiar ſymptoms diſtinguiſh them.

DCCC.

Cartilaginous Coats.

This is a common diſeaſe of the ſpleen, the covering of its convex ſurface ſuffering more or leſs this change. It varies in thickneſs in different caſes, reſembling, in appearance, the cartilage of the noſe, conſiſting of a ſmall layer, but at times irregular. The proceſs muſt naturally be ſlow, and hence no peculiar ſymptoms indicate the change.

DCCCI.

Enlargement.

Enlargement of the ſpleen, without diſeaſe, is a frequent appearance, and requires therefore only to be noticed.

DCCCII.

Hydatids.

Hydatids affect the ſpleen in the ſame manner as the liver, though leſs frequently.

Symptoms.

The marks of this affection are, pain of the left

hypochondrium, with ſwelling ſpreading ſlowly into the cavity of the abdomen, having a ſoftneſs to the feel, and ſenſe of obſcure fluctuation.

DCCCIII.

Concretions, &c.

Stony concretions have been noticed as an appearance obſervable in the ſpleen at times. Its rupture, alſo, has occaſionally occurred in conſequence of external preſſure, though this can only take place when it is much enlarged. A ſpecies of peculiarity is alſo marked at times in the ſtructure of this organ, being an appearance of ſeveral ſmall ſpleens, as well as the large one. Some of theſe equal in ſize a walnut, are ſituated in the omentum, and derive their circulation from the ſplenic artery and vein. This organ has been likewiſe found wanting at times, and no difference has been experienced in the apparent ſtate of health or exerciſe of the vital functions.

DCCCIV.

MORBID CHANGES OF THE PANCREAS.

Theſe are fewer than in moſt of the other organs, as diſſections evince.

DCCCV.

Abſceſs.

Abſceſs, however, here, has been met with, attended with an enlargement of the organ, and the diſcharge of a conſiderable quantity of pus.

Symptoms.

The ſymptoms of this affection are, more a diffuſed pain of the abdomen than fixed in the ſeat of the organ. Spaſms of the inteſtines and abdomen alſo attend, and ſickneſs, and diarrhœa. Pains of the back and loins have been alſo noticed

DCCCVI.

Hardneſs.

A hardneſs of this organ, with its thickened ſtate, and ſhortened in ſize, is a common appearance, and ſeems the commencement of its ſchirrus. When actual ſchirrus takes place, its ſtructure is enlarged and changed into a uniform white maſs, interſected by membranes as elſewhere.

Symptoms.

This ſtate, when advanced, has been marked by continued pain in the epigaſtric region, and ſickneſs at the ſtomach, with a ſenſe of hip pain, and numbneſs of one leg and thigh.

DCCCVII.

Calculi.

Calculi, of a white colour, are formed in the duct of this organ, and have been found equal in ſize to a hazel nut. They are eaſily diſſolved in the muriatic acid, and therefore differ from urinary calculi.

Symptoms.

The ſymptoms of calculi here, can only be thoſe which commonly attend irritation; but they

poſſeſs no peculiar marks of diſcrimination, ſo as to aſcertain the exiſtence of the diſeaſe.

DCCCVIII.

Defect.

This organ has been found wanting in ſome rare inſtances.

DCCCIX.

Diseased State of the Kidneys.

Inflamed Capſule.

The inflammation here is a rare occurrence, from its looſe connection with the peritonæum. When it happens, the ſame appearances will be exhibited as in inflammation elſewhere.

Symptoms.

Inflammation of the kidneys is marked by pain felt in their ſituation, ſhooting along the courſe of the ureters, with a ſenſe of numbneſs in the thigh, or retraction or pain in the teſticle. The ſymptoms are only felt in the ſide affected. The diſcharge of urine varies in colour, being moſtly of a deep red. Sickneſs and vomiting attend here, as alſo coſtiveneſs, and occaſionally cholic, joined with ſymptomatic fever.

DCCCX.

Abſceſs.

Inflammation of the kidneys terminates in ſuppuration and abſceſs more frequently than that of any other gland in the body, and theſe abſceſſes poſſeſs a ſcrofulous diſpoſition, appearing in the

form of one or two circumscribed sores, full of curdy matter. The inner surface is also lined occasionally with a pulpy matter.

The effect of such abscesses is to destroy, first, the mamillary portion, and afterwards, in their progress, the whole structure of the kidney, so as to change it into capsules surrounding a number of morbid cavities; and these capsules are frequently thick, laminated, and of considerable hardness. In its progress the affection generally extends to the pelvis and ureter.

Symptoms.

The formation of abscess in the kidneys is known by the mixture of pus with the urine; and the quantity of pus will somewhat determine the state of the affection.

DCCCXI.

Tubercles.

A tuberculous state of the kidney is very rare. Where it appears, it resembles in its appearance the tubercle of the lungs.

Symptoms.

No external symptoms discriminate this affection.

DCCCXII.

Schirrus.

Schirrus of the kidney exhibits a plain, brown, uniform substance, intersected by membranes, with an enlargement of the gland. It is, however, a rare appearance here; and where it occurs in

the whole of the kidney, it muſt be attended with the very worſt ſpecies of dropſy. If the diſeaſe occurs from a ſchirrus of the liver, it is formed of the milder parts of the blood, and the water is coagulable by heat: but when the matter paſſing by the urine is extravaſated into the cavities of the body moſt readily yielding to it, and even in the ventricles of the brain, which frequently is the caſe, it muſt be attended with the worſt conſequences; and where the obſtruction is lower, the effect is nearly the ſame as when it is in the kidney itſelf.

Symptoms.

The ſymptoms have never been juſtly diſcriminated.

DCCCXIII.

Diabetic State.

Diabetic kidneys ſhew an increaſed vaſcularity of ſtructure with the ſuperficial veins, diſplaying a fullneſs of their contents, and forming a net-work. The appearance of the kidneys in this diſeaſe is much like that of inflammation. A quantity of whitiſh fluid, reſembling pus, is alſo detected in the ſubſtance of the kidney.

Symptoms.

The ſymptoms of diabetes are, the increaſed quantity of urine of a ſweetiſh taſte and watery colour, great thirſt, and voracious appetite, with an increaſe of pulſe, and gradual emaciation.

DCCCXIV.

Softneſs.

The kidney appears, at times, converted into a looſe maſs, like a ſponge; and this ſpongy ſtructure is found, on diſſection, to pervade every part of it. This is a peculiar proceſs, by which part of its ſubſtance is abſorbed, and the cortical part in this abſorption ſuffers moſt.

Symptoms.

No general ſymptoms can detect this peculiar ſtate.

DCCCXV.

Hydatids.

Hydatids in the kidneys are not ſo common as in the liver. One or two large ones, however, are ſometimes conſpicuous on its ſurface, ſituated between its ſubſtance and capſule, and occaſionally their number is even greater. They are of a pulpy nature, with thin coverings, the ſame as any other membrane, and they are found here alſo only of one ſize. But the true hepatic hydatid is alſo to be met with in the kidney, occaſioning a change of the whole internal ſtructure of the organ, and contained in a thick laminated bag, often of a cartilaginous hardneſs. Being of different ſizes, from that of an orange to not more than the head of a pin, ſome of them have been voided by urine, occaſioning much exertion in the bladder to expel them, and producing, of courſe,

an increafed thicknefs of its mufcular coat, like other caufes of obftruction.

Symptoms.

The only fymptoms here are, pain felt in the loins during the formation of the difeafe, along with fymptomatic fever, naufea, and vomiting; but thefe attend alfo affections from another caufe, fo that the paffage of the hydatids by the urethra is the only certain criterion of their exiftence.

DCCCXVI.

Calculi.

The kidneys are the moft frequent feat of calculi, and they appear lodged either in its body, or in the pelvis of the ureter; where, by their ftay, increafing in fize by new depofitions, they affume from the fhape of their fituation an arbofcent form. In their colour, they are either white, or affume different fhades of brown; and their furface, though at times fmooth, is for the moft part roughened and irregular. The obftruction they form to the paffage of the urine, occafions an alteration in the ftructure of the organ, the pelvis and cavity of the kidney becoming very much enlarged; and the ureter alfo fuffers a change in the fame manner, according to the particular part of the organ at which the calculus occafions an obftruction. So enlarged does the kidney at laft become, as to lofe entirely every appearance of its natural ftructure,

and to confift folely of a capfule containing a number of cells; yet, even with this lofs of ftructure, the powers of fecretion in the organ ftill remain entire as before, and the urine is feparated in the fame quantity, and entirely of the fame nature.

As a calculus occurring here is a frequent caufe of inflammation in the kidney, perhaps an inflammation here difpofes to the growth of calculi; feveral circumftances lead to that notion. Some perfons are more fubject to calculous concretions than others, and there is no doubt a conftitution that difpofes to it; this is chiefly in the kidney; and a morbid change may be made by inflammation, which gives that difpofition. It begins to be formed long before the urine is extravafated. Small particles of calculi are obferved within the tubuli; and, as the inflammation is often evidently brought on by calculi; fo, if fuch perfons get cold, or are affected by intemperance, there is an uneafinefs of the kidney, and a difcharge of fand, and here the pain of the kidney feems to be the confequence of this want of attention.

Symptoms.

The fymptoms of calculi, and thofe of inflammation, are much the fame, except that in the former there is a depofition of red cryftals on the difcharge of urine, an occafional mixture of blood, and an increafed pain of the loins on motion.

DCCCXVII.

Offification.

The change of the kidneys into earth and offeous matter, has been ftated by authors; but thefe are appearances that muft be extremely rare, and barely deferve notice.

DCCCXVIII.

Variety.

The kidneys difplay much variety from original formation, both in their fituation and ftructure, being occafionally joined together, or before the lumbar vertebræ, or at the fides of the pelvis; and in fome inftances they are very fmall, or this is only on one fide, and the other is enlarged. Sometimes the kidney of one fide is wanting.

DCCCXIX.

Morbid Changes of the Renal Capfules.

Thefe are rarely affected by difeafe. An inftance or two of their abfcefs has been ftated, and alfo their fwelling from a fcrofulous caufe; for their enlargement, and their being filled with a white matter, fhewed fuch a difpofition. Their converfion into cartilage, and even the appearance of ftony particles in their fubftance, has been alfo detected.

DCCCXX.

DISEASES OF THE BLADDER.

Inflammation of the Peritonæal Coat.

Inflammation only takes place here when it is

general over the membrane, and it is usually confined to it, and does not extend to the other coats of the bladder from its loose connection to them, and the interposition of cellular matter. A consequence of this inflammation is adhesion of the bladder to the neighbouring parts, in the male to the rectum, and in the female to the womb.

Symptoms.

The symptoms are chiefly pain and heat in the region of the bladder, without much influence on the functions of the organ.

DCCCXXI.

Inflammation of the Bladder.

The inflammation of the inner membrane is more or less extensive, from its spreading over the whole organ to its affecting merely a particular part; and, when partial, the vicinity of the neck is generally the seat of it. The appearance of this inflammation consists in an increased vascularity, and frequently extravasation of blood. The muscular coat, however, is commonly not affected.

Symptoms.

This affection is attended with pain and fullness in the peritonæum, or above the pubes, with frequent small and painful micturitions, or a total retention of the discharge, attended with urgent desire. Tenesmus of the rectum also takes place, and the stomach sympathizes, being affected with sickness

and vomiting. Not unfrequently delirium prevails. The formation of pus is marked by its appearance in the urine difcharged.

DCCCXXII.

Ulceration.

This is often a confequence of the former affection terminating in fuppuration; and when ulcers are of the common kind, no peculiar circumftances mark their appearance here. In their effects, a portion of the bladder is often deftroyed, and communications are thus formed between it and the neighbouring parts, either with the abdominal cavity, or the rectum in the male, or vagina in the female. The confequence of the firft is general peritonæal inflammation; of the two laft, much irritation and pain, and the difeafe often continuing for life.

Local violence is generally the caufe of abfcefs here, and particularly the operation of lithotomy. In fome cafes, the inner membranes of the bladder has been entirely feparated by the procefs of apparently fcrofulous ulceration.

Symptoms.

The fymptoms of ulceration here are marked by pain and difficulty in making water; and where communications are opened by ulceration, the paffage of the urine detects thefe; and the pain and irritation, from affecting the parts it pervades.

DCCCXXIII.

Schirrus and Cancer.

Theſe diſeaſes are only communicated here from neighbouring parts, and are ſeldom original, being extended either from the rectum or uterus. In this ſituation they are characteriſed by the ſame thickneſs and hardneſs as when affecting other parts, and communications neceſſarily prevail with theſe parts.

DCCCXXIV.

Fungus.

Fungus appears on the inner ſurface of the bladder, either in one maſs, or detached pieces, which ſeem compoſed of a looſe fibrous texture. If ſituated behind the neck, obſtruction of the urine is the conſequence; and a ſtronger action required to expel it, occaſions a thickening of the muſcular coat.

Symptoms.

The difficult diſcharge of urine is the only ſymptom of fungus; and if it is ſituated near the neck, it may perhaps be aſcertained by the introduction of the ſound, which touching it, will give the feeling of a ſoft tumor; and an examination of the rectum will mark its diſtinction from a diſeaſed proſtate.

DCCCXXV.

Polypus.

Polypus of the bladder has been obſerved, con-

fiſting in various irregular projecting maſſes of a firm texture; but this appearance is very rare, and the ſymptoms are the ſame with thoſe of the fungus.

DCCCXXVI.

Elongation of the inner membrane forming irregular proceſſes in certain parts, conſiſting of much cellular membrane intermixed with fat, is an appearance obſervable in the bladder at times.

Symptoms.

This diſeaſe muſt be ſlow in its progreſs; neither will any inconvenience attend it, unleſs it preſſes on the neck, when a difficulty of water will enſue.

DCCCXXVII.

Cyſts.

Cyſts of various ſizes are found intimately connected with the bladder, and opening into its cavity. They are probably pouches formed from the bladder itſelf, though they are often found of a prodigious ſize.

DCCCXXVIII.

Thickneſs of the Muſcular Coat.

This is the common conſequence of all diſeaſes where the action of the bladder is much increaſed. From $\frac{1}{6}$ inch, its natural thickneſs, it is increaſed at times to half an inch; ſtill retaining, however, its pale colour, without any additional redneſs, and having between the faſciculi, or its inner fibres,

little pouches from the inner membrane. Thefe pouches equal at times, in fize, the extremity of the little finger, and fmall calculi are contained in them. This is more a difeafe of the male than of the female.

Symptoms.

The fymptoms of this difeafe are, frequent inclination to void urine, from the fmall capacity of the bladder to contain it.

DCCCXXIX.

Divifion of the Cavity.

The bladder has been obferved divided into two chambers, an upper and a lower one, feparated by firm membranous fubftance, and having an aperture of communication.

Symptoms.

The fymptoms of this difeafe in its advanced ftate are, a confiderable circumfcribed tumor above the pubes in the fituation of the diftended bladder, a leffened difcharge of urine, and no way affecting the fize of the tumor when difcharged. At times, a large emiffion of urine, from the choice of fome particular attitude, enabling it to defcend into the lower chamber, and the tumor of the pubes fubfiding in confequence of this, with a releafe of fymptoms till a new accumulation.

DCCCXXX.

Calculi.

Calculi are a frequent difeafe in the bladder,

affecting the male oftener than the female, and confpicuous at every period of life. The origin of this affection is either from the kidneys defcending by the ureters, or it is found in the bladder itfelf. An extraneous fubftance, forming a nucleus, is fometimes the caufe of thefe calculi, either loofe, or confined to a particular part of the organ. In the latter cafe, they are fometimes lodged in cyfts formed by the inner membrane, or attached to an excrefcence of the bladder, retaining it in that fituation. Where one calculus only exifts, it is commonly of an oval form; where more, they acquire by friction flat fides and angles. In general, the furface of calculi is granulated, from which they acquire a certain degree of roughnefs, and this roughnefs varies in different cafes, according to the fize of the granules; occafionally, inftead of this, the furface appears of a porous ftructure. The divifion of calculi exhibits a laminated texture in concentric curves compactly applied, and varying in the thicknefs of the laminæ. At times, alfo, a porous ftructure is confpicuous. The colour of calculi is very various, but brown chiefly prevails, of different degrees; and the colour of the fame calculus varies in different places, the outfide being of one colour, and the infide of another. Both the fpecific gravity of different calculi, as well as their chemical qualities, differ widely from each other;

and though the matter of calculus is thus found in the bladder, for the moſt part formed into one or more circumſcribed maſſes, there are inſtances where the whole of its cavity is filled with a ſubſtance like mortar.

Symptoms.

The ſymptoms of calculus are well aſcertained, and conſiſt of an uneaſineſs at the orifice of the urethra after the diſcharge of urine, or any exertion, with more or leſs of a dull pain at the neck of the bladder. Frequent micturition alſo takes place, paſſing either in drops, or with the ſtream ſuddenly ſuſpended. The urine diſplays a large depoſition of mucus, and is alſo occaſionally tinged with blood. Teneſmus is likewiſe a common ſymptom.

DCCCXXXI.

Diſtenſion and Contraction.

Diſtenſion of the bladder occupying the lower part of the abdomen, is a very common appearance on diſſection; and, in an oppoſite extreme, it is alſo diſcovered at times ſo contracted, as hardly to diſplay any cavity ariſing from its ſtrong action before death.

DCCCXXXII.

Defect of the Anterior Part.

A want of this part occaſionally appears; the place of which is ſupplied by a ſoft, vaſcular, fleſhy texture, externally ſituated on the abdomen,

and formed of projecting maſſes, having on them a layer of thick ropy mucus. On this maſs the ureters open, and it is attended with malconformation in the parts of generation.

DCCCXXXIII.

Communication with the Rectum.

A connection of the rectum with the dependent part of the bladder is ſometimes met with, being the effect of original malconformation; and another, though a rare appearance, is the bladder being found lodged in a hernial ſac, both at the abdominal ring and under Poupart's ligament.

DCCCXXXIV.

MORBID CHANGES OF THE MALE GENITAL PARTS.

Inflammation of the Veſiculæ Seminales.

The veſiculæ ſeminales are occaſionally the ſubject of diſeaſe, though it is difficult to detect it. Their inflammation is generally derived from that of the contiguous parts; and, in conſequence of this, adheſions have been formed by them; and likewiſe ſuppuration has taken place in their ſubſtance.

Symptoms.

No peculiar ſymptoms can mark inflammation here diſtinct from that of the other contiguous parts.

DCCCXXXV.

Scrofulous Accumulation.

The appearance of a ſcrofulous matter has alſo been traced in the veſiculæ ſeminales.

DCCCXXXVI.

Malconformation, &c.

The ducts of the veſiculæ ſeminales are occaſionally wanting, or do not open into the cavity of the proſtate gland. By the ſemen being thus prevented from paſſing into the urethra, ſterility muſt be the natural conſequence. A morbid ſmallneſs of their ſtructure has been alſo detected, rendering them unfit for the execution of their functions, though one is often found ſmaller than the other. Even one of them has appeared wanting, in which caſe the vas deferens of that ſide being enlarged and tortuous, has probably ſupplied its place. Schirrus and calculi of theſe parts have been alſo noticed.

Symptoms.

None of theſe affections have been diſtinguiſhed by any leading ſymptoms in the living body, and diſſection only has made known their exiſtence.

DCCCXXXVII.

Diseases of the Prostate Gland.

Abſceſs.

The appearance of abſceſs in the proſtate gland ſhews its being ſubject to the common attack and progreſs of inflammation, and this abſceſs poſſeſſes nothing peculiar more than abſceſs of other parts.

Symptoms.

The marks of inflammation here will be pains more or leſs acute at the neck of the bladder,

with difficulty in making water, and ſome teneſmus; and the quick progreſs and acuteneſs of pain will diſtinguiſh it from ſchirrus.

DCCCXXXVIII.

Scrofula.

The proſtate, on diſſection, often diſcloſes the ſame curdy matter as in other ſcrofulous glands, and pus has been preſſed from it in this ſtate.

DCCCXXXIX.

Schirrus.

Schirrus, however, is the moſt common affection of the proſtate gland; and the conſequence of this is, its enlargement to equal the ſize of the fiſt, diſplaying on diſſection the marks of ſchirrus elſewhere, or a firm white or brown ſubſtance, interſected by membranous ſepta in various directions. In this ſtate, its poſterior extremity projects deep into the cavity of the bladder, by which the urinary diſcharge is interrupted from entering the urethra, and that in a greater or leſs degree, according to the extent of this projection. Where this is very great, an inſtrument cannot be paſſed, and an artificial paſſage is ſometimes made by the ſide of the gland. In this way life is often protracted under this diſeaſe. The gland, alſo, often aſſumes an irregular growth, and a winding paſſage is formed through it by the change in the ſhape of its cavity, which increaſes the difficulty of making water. Not unfrequently with its en-

largement its surface becomes ulcerated, and a fistula occasionally appears between it and the rectum. From a diseased prostate gland the bladder naturally suffers; and being excited constantly to extraordinary exertions, its substance becomes thickened and stronger. This affection is a disease of advanced life.

Symptoms.

The marks of a diseased prostate gland are, difficult micturition, and in small quantity, sometimes a total suppression of it. The same uneasiness attends the passage of the fœces, and a continuance of the desire after it is over. Mucus from the urethra frequently follows these evacuations, from the exertion employed. The introduction of a bougie or catheter detects the disease by the place of its stoppage.

DCCCXL.

Calculi.

Small brown calculi of the size of a pea are occasionally found in the ducts of the prostate, and consist chiefly of phosphate of lime.

Symptoms.

The only symptoms here will be difficulty of urine, and the feeling to a sound, or catheter, of a stone impacted in the neck of the bladder.

DCCCXLI.

Enlarged Ducts.

The enlargement of the gland, and wideness of

its ducts, fo as to equal the fize of a fmall quill, fometimes appears. This ftate is always the effect of ftricture in the urethra, which obftructing the paffage of the urine, occafions its accumulation behind, and its dilatation of thefe parts; while the bladder itfelf fuffers from the fame caufe, and a thickening of it alfo attends this affection.

DCCCXLII.

Preternatural Smallnefs.

The proftate gland has been found in an oppofite extreme preternaturally fmall, fo as to be unfit for performing its functions. But this malconformatien was extended to other parts of the genital fyftem.

DCCCXLIII.

Morbid Changes of the Urethra.

Abfcefs.

The membranous part of this paffage is the feat of abfcefs, and it may arife from external or internal caufes; but obftruction of the urethra from ftricture is the moft frequent fource of this malady. By the irritation of the urine behind the ftricture, inflammation and its confequences are induced, and an abfcefs breaking externally, the urine is difcharged through the aperture.

Symptoms.

Stricture of the urethra is marked by more or lefs difficulty in the difcharge of urine, which is in a fmall forked ftream, fcattered as it were; and

often it paſſes in drops. Some gleety appearance likewiſe attends. Various ſymptoms ariſe in the contiguous parts from ſympathy, and conſtitutional irritation is frequently connected with the local affection.

DCCCXLIV.

Fiſtula.

The continuance of the former affection, with no diſpoſition to heal, conſtitutes fiſtula here; or the parts acquire a thickened hardneſs, and the lips of the orifice turn callous. The moſt common ſeat of this diſeaſe is behind the ſcrotum, or near the membranous diviſion of the urethra; and theſe fiſtulæ frequently diſplay ſeveral openings into ſhort canals, which run in various directions.

Symptoms.

This affection is conſpicuous by the external ſymptoms.

DCCCXLV.

Calculi.

By the compaction of calculi, the membranous part of the urethra is formed into a bag, often ſo large as to contain a ſmall egg; and, by the contact of the urine, the calculus in this ſituation gradually increaſes, as elſewhere. The marks of this ſtate are evident on external examination.

DCCCXLVI.

Cowper's Glands.

Cowper's glands have been mentioned as changed

into ligament; but diffections feldom fhew them the fubjects of difeafe.

DCCCXLVII.

Inflamed Membrane.

The inflammation of the inner urethral membrane is fimilar to that of other fecretory membranes. It difplays in this ftate an increafed vafcularity, and an augmented fecretion of its glands. The feat of this inflammation is generally at its anterior extremity, but the inflammation fpreads through its whole furface; nor is it confined to the membrane alone, but fpreads into the fubftance of the fpongy parts, affecting its whole ftructure. The confequence of its thus extending is increafed thicknefs and hardnefs of thefe parts, and the depofition of coagulable lymph into the cells, which thus acquire a more vafcular ftate. Even the glands become augmented, and feel like round tubercles to the finger.

Symptoms.

External fymptoms mark fufficiently this ftate of difeafe.

DCCCXLVIII.

Ulcers.

This is a very rare appearance in the urethra, as the inflammation here feldom extends that length.

Symptoms.

Much pain at a particalar part, and a difcharge

from it mixed with blood, will give ſome evidence of this ſtate.

DCCCXLIX.

Stricture.

Stricture was formerly noticed as the moſt frequent affection of this part, by which the canal is partially narrowed, or altogether obliterated. Its moſt common ſeat is a little anterior to the membranous diviſion of the urethra; and here it exhibits various appearances, as conſiſting either in a ſimple approximation of the oppoſite ſides of the paſſage, or in its contraction for a certain extent, either attended with the apparent natural ſtate of its ſurface; or its thickening and hardneſs, with a partial abraſion or ulceration.

Theſe conſequences are often augmented by mechanical attempts at relief, the ulcerations being extended, and not unfrequently even a new paſſage formed. The ſtricture alſo prevails in different places, and is at the ſame time irregularly placed on one ſide, ſo as to give obliquity to the paſſage.

Symptoms.

The ſymptoms of this affection were already detailed as a cauſe of inflammation.

DCCCL.

Caruncle.

An excreſcence from the urethra is a rare occurrence. In ſcrofulous conſtitutions, however,

it is occafionally obfervable on diffection, and therefore falls to be noticed.

Symptoms.

The fymptoms of this affection cannot differ from thofe of ftricture.

DCCCLI.

Earthy Matter.

The depofition of an earthy matter in the bladder, formerly noticed, may be even extended here; and, accordingly, a thin layer of this fubftance has been found to pervade the whole canal.

DCCCLII.

Malconformation of the Orifice.

The external opening of the urethra is fometimes found to be placed under the frænum, or where it fhould be, for in fuch cafes no frænum exifts. The opening here is alfo fmaller than the natural one. Some other fpecies of malconformation are at times met with, but they are very rare.

DCCCLIII.

DISEASED TESTICLES.

Hydrocele.

A collection of water in the vaginal coat of the tefticle occurs at every period of life; but after manhood, it feldom fuffers a fpontaneous termination. A pyramidal bag, more or lefs thickened and laminated, approaching the ring of the abdominal mufcle, and extending at times to the ring

itſelf, is its common appearance. By this accumulation the teſticle ſuffers compreſſion. The fluid contained poſſeſſes the properties of the ſerum, and from undergoing a morbid change, acquires a yellowiſh, greeniſh, or brown colour.

Symptoms.

The ſymptoms of this affection are determined by the pyramidal ſhape of the ſwelling, by its want of pain, by its reſiſtance on preſſure, by its having no influence on the general health, and by its tranſparency to the eye, when it is oppoſed to the light of a candle placed on the other ſide of it, or at leaſt by its compreſſibility, where the thickening of the coat prevents this tranſparency being ſo diſtinct.

DCCCLIV.

Hydatids.

This appearance has occaſionally been found within the vaginal coat, both looſe, and in a ſtate of adheſion; but the affection is rare.

Symptoms.

The marks of this affection will be the ſame as hydrocele, but its peculiar nature can only be diſtinctly known by opening the ſwelling.

DCCCLV.

Cartilages.

The vaginal coat is alſo at times the ſeat of cartilaginous ſubſtances, looſely placed in the cavity, and of the ſame nature as thoſe appearing

occaſionally in the joints, from a deranged ſecretion of the veſſels.

Symptoms.

As they are productive of no great inconvenience, no peculiar ſymptoms mark their preſence.

DCCCLVI.

Adheſion.

The vaginal coat becomes cloſely attached to the teſticle by a firm adheſion, either through its whole extent, or only in detached points, varying in their thickneſs of texture. They are always the conſequence of previous inflammation of the part.

DCCCLVII.

Inflammation of the Teſticle.

This gland is often ſubject to inflammation, which varies no way in appearance from that of other parts. The inflammation generally extends to the vas deferens and the ſpermatic cord, which occaſions a thickening of the coats of the former, and the veins of the latter ſometimes acquire a varicoſe ſtate. The inflammation is often ſucceeded by a permanent hardneſs and ſwelling of the epididymis, ariſing from extravaſation during the height of inflammation.

Symptoms.

Inflammation here is diſtinguiſhed by the uniform ſmooth ſwelling, by the rapidity of the inflammation, and by the inflammatory bluſh or roſy colour of the teguments.

DCCCLVIII.

Abſceſs.

Abſceſs here is a conſequence of inflammation, though not ſo frequent as in other parts; but it poſſeſſes here no peculiarities.

DCCCLIX.

Scrofula.

Scrofula here changes the teſticle into an enlarged maſs, which, when cut into, diſplays a white or yellowiſh curdy ſubſtance, mixed with pus in a greater or leſs degree.

Symptoms.

The chief marks of this diſeaſe are, a ſoftneſs of texture, a ſlight pain in the part, and a general healthy ſtate of the ſyſtem.

DCCCLX.

Pulpy State.

The natural ſtructure of the teſticle often degenerates into an entire brown, uniform, pulpy matter. This is a peculiar diſeaſe, equally diſtinct from ſcrofula and ſchirrus.

Symptoms.

The ſymptoms are the ſame as thoſe which mark ſcrofula.

DCCCLXI.

Schirrus and Cancer.

A browniſh hard maſs, interſected in various degrees by membranes, characterizes ſchirrus of this gland, where the natural ſtructure is loſt in

cells containing a ſanious fluid, with an occaſional mixture of cartilages. In the progreſs of the diſeaſe, the appendages of the teſticle, or the epididymis and the ſpermatic cord, take on the ſame morbid diſpoſition. The ulceration of this maſs, and its producing a fungous growth, conſtitutes cancer.

Symptoms.

The chief marks of this diſeaſe are, its great hardneſs, and darting pain extending along the cord, joined to its ſlow progreſs and particular influence on the general health. In the ulcerated ſtate the ſymptoms are obvious.

DCCCLXII.

Cartilage and Bone.

In ſome ſchirrous caſes a predominance of cartilaginous ſubſtance prevails, marked by ulceration in its centre; and this cartilage differs in nothing from common cartilage. A partial appearance of oſſeous matter in the teſticle has alſo, at times, been met with.

DCCCLXIII.

Malconformation of the Epididymis.

The termination of the epididymis in the vas deferens has been wanting at times. By this defect, the ſemen not being expelled into the urethra, ſterility muſt be the conſequence. Stricture of the vas deferens alſo occurring from diſeaſe, muſt be attended with the ſame effect in regard to one teſticle.

DCCCLXIV.

Smallneſs and Waſting.

Smallneſs in the teſticle, which ſometimes takes place in an extreme degree, is always attended with a want of venereal inclination. Waſting of the teſticle alſo occurs as an effect of diſeaſe, either of inflammation or compreſſion. This waſting has been known in both teſticles. When occurring only in one, the natural powers continue as before. When one teſticle does not deſcend at birth, but is continued in the abdomen, which ſometimes happens, it remains of an imperfect ſize in that ſituation.

DCCCLXV.

Morbid Changes of the Spermatic Chord.

The ſpermatic chord is liable to four different affections: ſchirrus, ſcrofula, varix, and dropſy.

The firſt of theſe is generally conjoined with that of the teſticle, by the affection of which it is changed into a hard maſs of the ſame nature with the teſticle itſelf, and at laſt its effects extend to the lumbar glands.

The ſecond is derived from the ſame ſource as the ſcrofulous ſtate of the teſticle, and exhibits the ſame appearance in the change of its ſtructure.

The third, or varix, is very common to this ſituation, and it takes place in the veins of the chord in various degrees, from ſimple enlargement to the moſt diſtended varicoſe ſtate. The chord

then becomes a bulky mafs, diminifhed on preffure, and very foft to the feel. From this increafe of the parts above, a wafting of the tefticle often enfues.

The fourth, or water, is found in this fituation in two different places, either diffufed in the cellular membrane of the chord forming a local anafarca, and readily diminifhed on preffure, though accumulated here to the quantity of fome pints; or, what is more common, the water here is encyfted and lodged in a fac of the fpermatic chord, formed by a firm white membrane full of ferous fluid.

Symptoms.

In the encyfted kind, the tefticle is found under the fwelling diftinct and feparate, in which it differs from hydrocele.

DCCCLXVI.

Morbid Changes of the Female Genital System.

Uterine Affections.

Inflammation.

The inflammation of the uterus is generally a confequence of parturition, when occurring; and its affection is extended, more or lefs, over the peritonæum. Its appearances are the fame with thofe of inflammation elfewhere, and its fundus and body are the chief feat of this morbid ftate. In its progrefs, it extends along the uterine appendages, and not unfrequently uterine inflam-

mation terminates in abſceſs, with pus collected in the large uterine veins. The peritonæal affection, conjoined with this, appears the ſame as under other morbid circumſtances, only there is here a proportionally greater extravaſation of coagulable lymph.

Symptoms.

The marks of inflammation here are, hypogaſtric pain and tenſion, increaſed on preſſure or examination of the uterine orifice. The ſtomach ſympathizing, vomiting enſues, attended with an irregular ſtate of the bowels, general fever, and much frequency of pulſe. On the peritonæal affection being conſiderable, added to theſe ſymptoms, ſwelling of the abdominal cavity takes place, with increaſed pain and tenderneſs.

DCCCLXVII.

Ulceration.

The ſeat of this morbid change is the neck of the uterus, from which it ſpreads to the fundus, ſo as to deſtroy the greater part of the organ, and convert it into a tattered maſs. From the uterus, it frequently ſpreads alſo to the contiguous parts, particularly to the vagina, bladder, and rectum, with all which it forms communications. In its firſt ſtage, the uterus becomes by it ſomewhat harder, and enlarged. The chief period of its attack is middle and advanced life, though it is occaſionally met with in young ſubjects.

Symptoms.

Pain, more or leſs exquiſite, in the part, with a purulent or bloody diſcharge, forms the leading ſymptom of the diſeaſe. Its progreſs, where communications take place with neighbouring parts, particularly the bladder, is marked by the diſcharge of urine from that ſituation. A ſmall frequent pulſe, ſallow look, and great emaciation, attend the advance of this malady, and ſwelling of the inguinal glands from abſorption.

DCCCLXVIII.

Schirrus.

A general ſchirrous enlargement and hardneſs of the uterus, to equal in ſize geſtation at ſix months, often occurs, ſhewing on diſſection a hard ſubſtance of a browniſh or browniſh white colour, interſected by membranes. An ulceration and tuberculous ſtate of its inner ſurface is a frequent effect of its progreſs, and theſe tubercles contained in its ſubſtance are ſimilar in ſtructure to the uterus itſelf.

Symptoms.

This diſeaſe is only known in its advanced ſtage by pain more or leſs acute in the hypogaſtric region; and by an examination of the ſtate of the uterus, by the vagina feeling at the orifice hard and enlarged, with a conſiderable weight of the organ when raiſed on the finger. Not unfrequently the enlargement may be felt by application of the

hand above the pubes. A difcharge will be joined with thefe fymptoms when it has paffed into ulceration.

DCCCLXIX.

Tubercles.

An external tuberculous ftate of the uterus, as well as an internal, the effect of fchirrus, is at times difcovered. Thefe tubercles vary much in fize, being irregular in fhape, and knotted. When cut into, they fhew the fame general appearance as fchirrus. One peculiarity is their fmall tendency to ulceration. Inftead of numerous tubercles, the uterine cavity is often filled by one large mafs of this kind, which exhibits, on diffection, the fame ftructure, and which is connected to the uterus only by loofe cellular membrane, while, except in its enlargement accommodated to the fize of this mafs, the organ is not otherwife affected by difeafe.

Symptoms.

No fymptoms mark this affection in its early ftate, and, in its advanced progrefs, it is no way to be diftinguifhed from fchirrus.

DCCCLXX.

Polypus.

This is the fame difeafe as the tubercle, only it differs in the manner of its connection with the organ, adhering always to it by a fmall neck. Thefe polypi vary in fize, from a walnut to the

magnitude of a child's head. The fundus is the moſt common ſeat of attachment, and more than one are generally found at a time in the uterus. Sometimes they differ from the tubercle, and conſiſt of a mere looſe bloody maſs, with tattered proceſſes from it. This maſs, when opened, is formed either of a ſpongy laminated ſubſtance, divided by interſtitial cavities, or of the ſame texture with larger ones. By theſe polypi the ſize of the organ is augmented in proportion to their bulk.

Symptoms.

Pains of the loins, with mucous and occaſional bloody diſcharges, are the leading ſymptoms here, till it is diſtinguiſhable by examination. The general health is little affected.

DCCCLXXI.

Inverſion.

Inverſion is the effect of a polypus, or the extraction of the placenta. In the firſt caſe it is partial when there is an appearance of fiſſure on the outſide, and the uterine appendages are drawn inwards at both edges of the fiſſure. In the ſecond caſe, the inverſion is complete, and the inner ſurface expands, while the fundus forms a large tumor within the vagina, and even extends without the os externum.

Symptoms.

The ſymptoms of incomplete inverſion can only

be gueſſed at from the exceſs of the diſcharge. When complete, examination will aſcertain it.

DCCCLXXII.

Prolapſus.

A diſplaced uterus, by the yielding of the ligaments, occurs in thoſe who have a large pelvis, or where the ſoft parts are much relaxed by labor. By this means it falls down, ſo as to occupy the external parts, or appears without them.

Symptoms.

This affection is obvious on examination.

DCCCLXXIII.

Stricture, &c.

Stricture occurs at that part of the uterus where the fundus ends in the cervix. The parts become here glued by ſome ſlight inflammation, or gradually approach each other ſo as to ſhut up the aperture. In the ſame way, the os uteri has been found cloſed up by the growth of a membrane, and its opening obliterated. A bony ſtate of the uterus has been alſo known, from a morbid ſecretion of its veſſels. It has likewiſe been changed into an earthy ſubſtance. Bone has alſo been found in its cavity, ariſing probably from a tubercle aſſuming this ſtate; and ſtones have not unfrequently occupied the ſame ſituation, varying in their colour, and correſponding to concretions in other glandular parts of the body. Even a dead fœtus has been changed into an earthy matter by

remaining a long time in this cavity, ſtill preſerving its original ſhape.

DCCCLXXIV.

Water.

Dropſy of the uterus is a diſeaſe in which a large accumulation has at times taken place, even to the extent of 100 pints, the fluid poſſeſſing a bloody or yellowiſh appearance, and being ſerous as in other caſes. A ſtricture of the cervix always attends this morbid ſtate.

Symptoms.

The evacuation of water only aſcertains the certainty of this ſtate.

DCCCLXXV.

Hydatids.

Hydatids of the uterus differ from thoſe in other ſituations. They conſiſt of veſicles of a round oval ſhape, having each a narrow ſtalk by which they adhere to each other. They differ much in ſize, from a walnut to a pin's head, and the larger poſſeſs ſmaller ones adhering to them by narrow proceſſes. It is probable they are connected with impregnation.

Symptoms.

No marks can diſcriminate this morbid ſtate till the expulſion of the hydatids, when it is attended with pains reſembling thoſe of labor.

DCCCLXXVI.

Rupture.

Rupture of the uterus is an accident occafionally taking place at the end of pregnancy, or in the courfe of labor. The fide of the uterus is generally the feat of it; and where the peritonæum remains entire, there is accumulated between it and the rupture much black coagulated blood, having much the appearance as if gangrene had taken place.

Symptoms.

The fymptoms of this accident, though it is only certainly known by examination, are, pain, with a feeling in the belly of fomething giving way, chocolate coloured vomiting, fufpenfion of labor pains, and a retraction of the prevefting part.

DCCCLXXVII.

Varieties.

The fize and thicknefs of the uterus varies in different cafes, and alfo its fituation being placed more or lefs laterally in the pelvis. A double uterus has alfo occurred as an inftance of malconformation.

DCCCLXXVIII.

Morbid Changes of the Uterine Appendages on the Ovaria.

Inflammation of the Coats.

Inflammation of the peritonæal covering of the

ovaria arſes from its connection with other parts, and is never original. When aſſuming this ſtate, it diſplays the ſame appearance as inflammation elſewhere; and the conſequence of this is the adheſion of the ovaria to the neighbouring parts.

DCCCLXXIX.

Inflamed Subſtance.

This only ariſes from inflammation of the uterus, and by this inflammation the ovaria become enlarged, hard, and vaſcular. Frequently pus is formed in them.

Symptoms.

The ſame ſymptoms attend this affection as that of the uterus.

DCCCLXXX.

Schirrus.

Schirrus is a leſs frequent affection of the ovaria than of the uterus. By its attack they are changed into an enlarged, hard, white maſs, interſected, as in other parts, by membrane; and not unfrequently the change into hardneſs proceeds the length of bone, with a greater proportion of earth in it than common bone.

Symptoms.

Schirrus here can never be determined but in a very advanced progreſs of the diſeaſe.

DCCCLXXXI.

Softneſs.

The ovaria becomes at times enlarged and

changed into a brown pulp, with cells containing a fluid. Much the fame appearance takes place when they affume a fcrofulous ftate.

DCCCLXXXII.

Dropfy.

The chief difeafe of the ovaria is dropfy, the whole fubftance being deftroyed, and changed into a bag containing a fluid. The fize of this is often large, firm, and white in its texture, while its fluid is capable of being in part coagulated. In this bag a number of cells are often alfo found, which communicate with each other, and at other times cyfts are found that have no communication. The fize of thefe cyfts is various, from a hazel nut to an orange; and their coats vary in their degree of thicknefs, and in the number and compactnefs of their laminæ. The fluid they contain is of various confiftence, from ferum to jelly; and it is not the fame in every cyft. Thefe cyfts adhere by broad furfaces to each other, and are only the natural ftructure of the ovaria enlarged.

Symptoms.

Dropfy of the ovarium, when advanced, is marked by an abdominal tumor on one fide, with an unequal furface and obfcure fluctuation, the general health little affected, and the urine no ways diminifhed.

DCCCLXXXIII.

Extraneous Productions.

The converſion of the ovaria into a fatty ſubſtance, having teeth and hair in it, is a ſingular change that at times occurs. They are incloſed by a capſule of a white ſtrong membrane. The hairs lie looſe in the fat, or adhere to the capſule. The teeth here want fangs; they are connected to the inner membrane of the capſule, or an irregular bony maſs. The origin of theſe productions are as yet inexplicable, though they do not appear connected with impregnation.

DCCCLXXXIV.

Fœtus.

An ovarial fœtus is a frequent appearance. It never arrives at any great ſize. The ſtructure of the ovarium becomes changed into a bag of ſome firmneſs; and on the inſide of the bag is attached the placenta, and part of the chorion. On this bag the Fallopian tube and ſpermatics can be traced. The uterus aſſumes the impregnated ſtate by an enlargement at the ſame time, and formation of decidua. Its veſſels are alſo augmented.

DCCCLXXXV.

Shrinking.

Age diminiſhes the ovaria to half their ſize, and renders them hard and tuberculated. Their veſicles, in this ſtate, are found filled with a white ſolid matter.

DCCCLXXXVI.

Defect.

The ovaria have been found wanting at times on both ſides, and occaſionally on one.

DCCCLXXXVII.

On the Fallopian Tubes.

The changes which the Fallopian tubes undergo, are ſimilar to thoſe of the ovarium. Thus inflammation is communicated to them from the uterus, and even their ſuppuration takes place. Adheſions are formed by them, in conſequence of inflammation, to the neighbouring parts, and particularly the fimbriated extremity of the tube is found adhering to the ovarium, or its ſtructure and aperture are entirely loſt. Dropſy alſo, from the adheſion of its two extremities, enſues. The aperture of the tubes is likewiſe at times wanting from malconformation, and an ovium has even been detained here in its deſcent, and increaſed in the tube to a conſiderable ſize, while the uterus is augmented, and receives all the other changes that take place, as if it had been depoſited there. The tube is even ſubject to aſſume the tuberculous ſtate, and to poſſeſs a growth of a firm white ſubſtance, interſected by ſepta the ſame as the uterus.

DCCCLXXXVIII.

On Round Ligaments.

Theſe parts are expoſed to the progreſs of in-

flammation from the uterus, and other affections which have been particularly noticed.

DCCCLXXXIX.

Diseases of the Vagina.

Inflammation.

Inflammation of the internal surface, near the os externum, is common from a venereal cause.

Symptoms.

The symptoms are such as constitute gonorrhœa.

DCCCXC.

Adhesion.

The effect of violent inflammation is, adhesion of the sides, more or less general; but it is mostly partial, and constitutes stricture.

Symptoms.

The marks of this are known by examination, and they may be previously suspected by the absence of the menses, and the inability of sexual intercourse.

DCCCXCI.

Ulceration.

Ulceration is here in various degrees, from a single spot on the internal surface to a foul ragged sore. These ulcers frequently arise from the uterus, and in their progress communications are formed by them with the neighbouring parts, particularly the bladder and rectum, which embitter existence.

Symptoms.

Examination is the fureft means of their detection, and they are attended with more or lefs pain, and a purulent difcharge.

DCCCXCII.

Schirrus.

Schirrus occurs here alfo without the fame ftate of the uterus, and nothing peculiar diftinguifhes its appearance here from what has been defcribed elfewhere.

Symptoms.

The chief fymptoms of it are, the glaffy, painful, hardened feel, which the affected part affumes.

DCCCXCIII.

Inverfion.

Inverfion or prolapfus here, is a frequent difeafe, produced by a wide pelvis, and a relaxed ftate of the foft parts, particularly the os externum. It is either complete or incomplete. When it is without the external parts, it difplays different fhapes, forming either a large rounded mafs, or being narrow and elongated, fo as to extend fome way from the furface of the body. This appearance conftitutes a fpecies of hermophroditifm. Where long inverted, the parts acquire a hardnefs, and inflammation and ulceration occafionally arife. Adhefion is alfo formed, while the uterus is in this prolapfed ftate, with the neighbouring parts, which

renders their reduction extremely difficult, and sometimes impossible.

Symptoms.

This complaint is marked by a sense of bearing down, and the passing up of a tumor through the vagina in the erect posture. Examination, however, is the surest test.

DCCCXCIV.

Deviations.

Three different deviations of the vagina from the natural dimensions, merit to be noticed.

1. The 1*st* is its shortness to half its natural length, which is the effect of malconformation, and is only known by examination.

2. The 2*d* is its extreme wideness, from the previous dilatation of polypi that have been removed; and,

3. The 3*d* is narrowness; which, in a morbid degree, is generally the effect of malconformation.

DCCCXCV.

MORBID APPEARANCES OF THE EXTERNAL PARTS.

Imperforated Hymen.

The conclusion of the vagina at its external extremity, is by means of a firm membrane, the effect of original formation, generally discovered at the period of menstruation, in consequence of the accumulation then taking place.

Symptoms.

Its symptoms consist in strong bearing down

pain, firſt occurring at every menſtrual period, and then departing; at laſt they become more continued as the accumulation, and of courſe the uterine irritation, increaſes.

DCCCXCVI.

Enlarged Clitoris.

This monſtroſity is often at birth larger than the penis of a male child, with a prepuce glans, and an external fiſſure, ſo as to imitate the appearance of the male. In its progreſs, however, the increaſe is not equal to the increaſe of the penis. An accurate examination of the general ſtate of the parts will detect the real nature of the malconformation.

DCCCXCVII.

Enlarged Nymphæ.

This enlargement ſometimes occurs in one, and ſometimes in both. When extended ſo as to paſs beyond the labia, the ſtructure becomes changed ſimilar to that of the labia, and it is inconvenient from the effects of friction.

DCCCXCVIII.

Adheſion of the Labia.

The labia are found united in two ways, either by a fine line not extended to the meatus urinæ and glans of the clitoris, or they are joined by a continuation of the common ſkin, by which the labial appearance is loſt. The parts here are the common ſeat of inflammation and ulceration from

a venereal cauſe, but theſe merit no particular inveſtigation.

DCCCXCIX.

Morbid Changes of the Brain and its Membranes.

Inflammation of the Dura Mater.

The appearances exhibited by the dura mater in a ſtate of inflammation are, its increaſed vaſcularity, though this never takes place in a high degree from its natural ſtructure; the lining of its inner ſurface with coagulable lymph, which is not frequent; and an adheſion between it and the other membranes of the brain to a certain extent; though this is alſo rare. Inflammation here often terminates by ſuppuration. Pus is found covering it, and even gangrene at times enſues. Ulceration, alſo, is a frequent appearance.

Symptoms.

The marks of this morbid ſtate are, pain of the head, delirium, general fever, and ſometimes convulſions, or a tendency to theſe.

DCCCC.

Attachment of Extraneous Subſtances.

The dura mater has at times tumors proceeding from it of a ſcrofulous or ſpongy nature, the former being diſtinguiſhed by the curdy pus on diſſection, the latter by their ſoft pulpy feel and apparent fibrous texture. Even bony laminæ are apt to form here, thin and irregular in their ſhape,

of various ſizes, and confined generally to the longitudinal ſinus or its falx, with a greater proportion of earth than common in their ſubſtance. The number of theſe oſſifications varies, and even the falx has aſſumed entirely this ſtate.

Symptoms.

The ſymptoms of tumor are marked by long-continued pain of the head, occaſional delirium, or convulſions, not unfrequently apoplexy.

When bone forms the cauſe, convulſions are more frequent, with continued pain of the head, and occaſional delirium.

DCCCCI.

Adheſion.

Morbid adheſion is a frequent appearance here, and is probably the effect of previous inflammation. It prevails ſo ſtrongly as to divide the membrane on attempting to ſeparate it into two layers, one adhering to the cranium, the other to the pia mater.

Symptoms.

No peculiar ſymptoms mark this.

DCCCCII.

Thickneſs of the Arachnoid Coat.

This is the only morbid appearance remarked here, and along with it a ſerous fluid is found interpoſed between it and the pia mater.

DCCCCIII.

Venous Turgidity of the Pia Mater.

This appearance occurs without marks of inflammation, and is the consequence of the obstruction of the blood in its passage to the heart, so that the veins here become distended with deoxydated or black blood.

Symptoms.

Stupor, delirium, and apoplexy, are the attendant symptoms of this state.

DCCCCIV.

Inflammation of the Pia Mater.

Inflammation here is difficult to distinguish from the natural vascular appearance of the membrane. The chief distinctions are drawn from the greater vascularity of its under processes, and their closer adhesion to the brain. Occasionally the formation of pus takes place, effused on its surface, and, more rarely, adhesion between it and the dura mater.

Symptoms.

The symptoms are the same here as inflammation of the other membranes already noticed.

DCCCCV.

Anomalous Appearances of the Pia Mater.

This membrane is subject to the attachment of scrofulous tumors; to the distension of its vessels with air, extricated in a peculiar manner from the circulation; to the adhesion of hydatids to its

fubftance, and even to the occafional converfion of it into bone.

Symptoms.

None of thefe circumftances have been characterized by any peculiar fymptoms.

DCCCCVI.

Diseased Appearances of the Brain.

The morbid appearances of the brain itfelf may be reduced to real change of ftructure, or fluid accumulations.

DCCCCVII.

Inflammation.

The firft of thefe changes is inflammation being confined to a fmall fpot, either of it or of the cerebellum, though this effect is rare without external violence. It exhibits only increafed vafcularity and rednefs, extending, if on the furface, to the contiguous membranes.

Symptoms.

The fymptoms of this ftate are, pain of the head, delirium, general fever, and coma.

DCCCCVIII.

Abfcefs.

Abfcefs of the brain is a frequent confequence of inflammation, by which its texture is broken when the collection is great, or the part ulcerated where it is fmall.

Symptoms.

The marks of this ftate are the fymptoms of in-

flammation, with paralyſis and convulſions, particularly where it is ſeated in the tuber annulare, or medulla oblongata.

DCCCCIX.

Gangrene.

Gangrene here is rare, and exhibits a dark brown appearance, with much ſoftneſs.

DCCCCX.

Softneſs.

Preternatural ſoftneſs of the brain is moſt conſpicuous near the lateral ventricles in the medulla of the hemiſpheres. It attends fatuity in age, and is combined with ſanguineous apoplexy.

DCCCCXI.

Firmneſs.

The oppoſite ſtate of the former is more common, joined with toughneſs and elaſticity to a great degree; and here an enlargement of the ventricles takes place, with an accumulation of ſerous fluid. Exceſſive dryneſs of the brain has been alſo noticed, and lightneſs of the medullary ſubſtance.

Symptoms.

Mania has been conſidered as the leading mark of this ſtate.

DCCCCXII.

Preternatural Formation.

In the ſubſtance of the brain, a ſmooth, uniform, firm, white ſubſtance is formed, to which

the brain adheres, with an increafed vafcularity of its edges. Similar rounded maffes appear in different parts of the brain, and in fuch cafes a ferous accumulation prevails in the lateral ventricles. This conftitutes fcrofula of the brain, the fubftances being occafionally converted into fcrofulous matter. Encyfted tumors are alfo at times an appearance in the brain, probably connected with the fame caufe. Bony tumors have been alfo noticed, confifting of an irregular mafs of offeous proceffes, filled up by a flefhy interftitial fubftance.

Symptoms.

The fymptoms of thefe various preternatural affections are, fixed pain or uneafinefs in the head, with occafional delirium, convulfions, and apoplexy. If paffing on to the optic thalami, defect of vifion is conjoined; if to the tuber annulare, or medulla oblongata, convulfion is the moft frequent fymptom.

DCCCCXIII.

Hydrocephalus, or Watery Accumulation.

Internal.

Perhaps the moft common difeafe of the brain is the hydrocephalus, where water is accumulated in its ventricles. It is a difeafe of childhood, from the moment of birth till near the age of puberty, though its attacks are confined to the three or four firft years of life. The quantity of accumulation varies in different cafes, from a few

ounces to as many pints. Where it is in excefs, by the raifing of the anterior end of the fornix, a communication comes to be formed between the lateral ventricles, and from the fame caufe alfo it extends into the 3*d* and 4*th*. The accumulation here confifts of ferum in a purer ftate than in the other cavities, though the proportion of its coagulable matter varies in different inftances. By much accumulation, the ftructure of the brain is changed more or lefs into a pulpy mafs, or containing bag. The bones of the cranium fuffer an extenfion from this difeafe, altering, alfo, in fome degree, their fhape, and the fkull greatly exceeds its ufual proportion to the face. The futures, however, form the chief places of the extenfion of the cranial cavity; but the bones are alfo thinned, and their fibres diftracted, which difplay membranous interftices. Such are the changes produced by long continuance of this difeafe.

Symptoms.

The fymptoms of this difeafe enumerated are, pain of the head, joined with ftupor and convulfions, occafional hectic, picking of the nofe, and grinding of the teeth; joined, when more advanced, with dilated pupils and fquinting. Sicknefs of the ftomach, and coftivenefs, commonly attend. The pulfe, at firft frequent and regular, becomes more flow and irregular as the difeafe proceeds to its laft ftage.

DCCCCXIV.

External.

The ſame accumulation has been known on the ſurface of the brain, confined by the pia mater. It is, however, rare, and perhaps rather conjoined with the former. It has been alſo known between the cranium and dura mater, and between the dura and pia mater; but theſe are rarely original ſtates of diſeaſe.

DCCCCXV.

Bloody Accumulation.

The effuſion of blood is common within many parts of the cranium. It depends generally on rupture; and this effuſion may be lodged in the cerebral ſubſtance in the ventricles upon the ſurface of the brain, or within its membranes, according to the particular cauſe of the rupture.

Effuſion here is either attended with a ſound or diſeaſed ſtate of the vaſcular ſyſtem of the head; and, in the firſt caſe, which is the leaſt common, the effuſion is the conſequence of external violence. The diſeaſed ſtate conſiſts in the large arterial branches of the head loſing their power of contraction in conſequence of taking on an oſſeous diſpoſition, and this diſpoſition they communicate to their ſmaller ramifications. The quantity effuſed varies, but is often conſiderable, and in a coagulated ſtate, the preſſure of which injures the organ. The ſeat of the effuſion is ofteneſt the

medullary part of the hemiſpheres, and near the lateral ventricles. A morbid ſoftneſs of the brain alſo may favour that effuſion.

Symptoms.

The ſymptoms of a membranous effuſion are, coma in different degrees; thoſe of an effuſion into the cerebral ſubſtance are, alſo, ſtertorous breathing, and palſy more or leſs complete, convulſions, with pulſe ſlow, full, and ſtrong. If life continues, theſe ſymptoms end in permanent hemiplegia.

DCCCCXVI.

Serous Accumulation.

This is generally confined to the medullary part of the hemiſpheres, which becomes lined with a firm membrane containing it.

DCCCCXVII.

Aneuriſm.

The only aneuriſm within the brain is that of the internal carotid, at the ſella turcica. It is connected with the diſeaſed ſtate of the artery; in advanced life is very rare; and the tumor has been found the ſize of a cherry.

DCCCCXVIII.

Morbid Change of the Choroid Plexus.

Diſtenſion of the vein at its edge produces here the appearance of hydatids, in ſize from a pea to that of a gooſeberry. It is an appearance, however, very rare. Scrofulous tumors alſo, of a

ſmall globular ſhape, are found attached to this part, and are equally rare.

DCCCCXIX.

Diſeaſes of the Pineal Gland.

The pineal gland is ſubject to various morbid changes. A depoſition of earth is found conſtantly in its ſubſtance, in a greater or leſs quantity; and a ſmall portion appears without diſeaſe. It is alſo ſubject to ſchirrus, acquiring a greater firmneſs than is natural; and water has even been found to diſtend its ſubſtance.

DCCCCXX.

Diſeaſes of the Pituitary Gland.

This gland has been found enlarged and changed into a ſomewhat firm fibrous texture.

DCCCCXXI.

Diſeaſed Nerves.

Nerves are ſeldom found diſeaſed. Where they are, they ſhrink in ſize, become ſofter than natural, and leſs opake in colour. In their original ſtructure, however, they vary in different caſes in their ſize.

DCCCCXXIII.

Malconformation of the Brain.

A conſiderable variety of malconformation in the origin of the nervous ſyſtem is met with. Often moſt of the cerebrum is wanting, while the cerebellum and ſpinal marrow are entire. Sometimes there is little appearance of either of theſe,

with the medulla ſpinalis at the ſame time of a ſmall ſize, while the nerves in general are of their proper form and ſize. Where the brain is wanting, the cranium is on a level with the eyes, and has its ſcalp covered with a ſoft ſpongy excreſcence, diviſible into diſtinct cellular maſſes, and having a fine vaſcular covering over it. Inſtead of this excreſcence, there often appears a conſiderable bag deſcending from the ſcalp over the back of the trunk, containing a ſerous fluid, and at times portions of brain, having a communication with the cranium.

DCCCCXXIII.

Morbid State of the Cranial Bones.

A general diſeaſed thickening of the whole cranial bones has at times occurred, ſo as to preſs upon the cavity of the brain; and with this thickneſs they acquire, at the ſame time, a ſpongy texture. A partial growth has alſo been noticed, or an ivory-like needle protruding into the cranial cavity, forming a permanent cauſe of compreſſion upon the brain. The natural irregularity of the inner ſurface of the cranial baſe, conſiſting in its ridges lengthening and forming ſharp ſpaculi, is a frequent ſource of irritation of the nervous ſyſtem.

DCCCCXXIV.

Forms of Injections used for Anatomical Preparations adapted to the different Kinds of Preparations commonly made.

1. In forming coloured injections, it is necessary, in order to their use, that they should be liquified by a degree of heat less than that of the boiling point, that the texture of the vessels to be filled may not be destroyed; and next, that it should remain somewhat solid, or rather ductile, when introduced; and again brought to the ordinary temperature. The only exception to this rule is in the corroded preparations, when the greatest degree of solidity in the injection is required.

2. Anatomical injections are of four kinds; *Coarse, Fine, Minute,* and *Mercurial.*

Coarse Injections.

The coarse is commonly employed for entire subjects or extremities, or for large vessels, where no minute parts are to be filled. It may be variously coloured; and its ingredients consist of the following proportions:

FORMS.

Red.

Yellow bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
Vermilion, 3 ounces.

The three first ingredients are to be liquified over a slow fire, and the vermilion afterwards added by mixing it first with a little of the liquified composition, and stirring it well with a wooden pestle. The whole of the ingredients being then blended together and heated, the injection will be fit for use.

Yellow.

Yellow bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
King's yellow, 2½ ounces.

White.

Fine bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
Flake-white, 5½ ounces.

Pale Blue.

White bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
Best flake-white, 3½ ounces;
Fine blue smalt, 3½ ounces.

Dark Blue.

White bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
Blue verditer, 10½ ounces.

Black.

Yellow bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;
Lamp black, 1 ounce.

Green.

Yellow bees wax, 16 ounces;
White resin, 8 ounces;
Turpentine varnish, 6 ounces;

Chryſtallized verdigriſe, $4\frac{1}{2}$ ounces;
Beſt flake-white, $1\frac{1}{2}$ ounce.
Gamboge, 1 ounce.

Fine Injections.

The ſecond kind of injection, or the fine, is appropriated for filling the ſmaller branches of the principal veſſels, part of which being firſt thrown in, is ſucceeded by the coarſe, to force it on and fill the minute parts. The forms of fine injection are:

FORMS.

Red.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
Vermilion, 1 ounce.

Yellow.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
King's yellow, $1\frac{1}{4}$ ounce.

White.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
Beſt flake-white, 2 ounces.

Light Blue.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
Fine blue ſmalt, $1\frac{1}{2}$ ounce;
Beſt flake-white, $1\frac{1}{4}$ ounce.

Dark Blue.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
Blue verditer, 4 ounces.

Black.

Brown ſpirit varniſh,
White ſpirit varniſh, of each 4 ounces;
Turpentine varniſh, 1 ounce;
Lamp-black, $\frac{1}{2}$ ounce.

When the coarſe and fine injections loſe part of their fluidity by frequent melting, a little more of the turpentine varniſh is to be added to the maſs, and the quantity may be judged of by its ductility.

Minute Injections.

The third kind, or minute injections, is adapted ſolely to the ſmaller ramifications of the veſſels; and the ſize being the chief part of the receipt, is thus prepared:

Take the fineſt glue or iſinglaſs, one pound; break the glue into ſmall pieces, and putting them into an earthen pot, pour on them three pints of cold water: when it has ſtood 24 hours, occaſionally ſtirring it, it is to be placed on a ſlow fire till diſſolved, which generally requires half an hour. When removed, and ſkimmed from its froth, and paſſed through a fine cloth of canvas or flannel, it is then fit for the additional ingredients.

Forms.

Red.

Size, 1 pint;
Vermilion, $3\frac{1}{2}$ ounces.

Yellow.

Size, 1 pint;
King's yellow, $2\frac{1}{2}$ ounces.

White.

Size, 1 pint;
Beſt flake-white, $3\frac{1}{2}$ ounces.

Blue.

Size, 1 pint;
Fine blue ſmalt, 6 ounces.

Green.

Size, 1 pint;
Chryſtallized verdigriſe, 2 ounces;
Beſt flake-white,
Gamboge, of each eight ſcruples.

Black.

Size, 1 pint;
Lamp black, 1 ounce;
Theſe injections do not keep unleſs they are dried.

The fourth kind of injection, or quickſilver, requires no particular preparation, but much nicety and caution in conducting the operations with it in order to be ſucceſsful.

END OF THE SECOND VOLUME.